Preface

This guide provides helpful information and instruction on how to configure VX-MD3024 system. All users should carefully read this guide before handling this product and follow all instructions. For reader comprehension, this manual contains detailed descriptions and practical examples of product configuration. This guide also provides the information you need to configure Layer 2, Layer 3 features and VDSL features on your system. The system administrator should be familiar with the concepts and terminology of Ethernet and Local Area Network (LAN) and should have technical networking experience and professional knowledge about network equipment.

For detailed information about the VX-MD3024, contact the customer center at the www.versatek.com home page. You can obtain the document about the VX-MD3024 and various information with questions.

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Organization

This guide is organized into these chapters:

Chapter 1, “Overview,” lists the software features of the release and provides examples of how the system can be deployed in network.

Chapter 2, “Using the Command Line Interface” describes how to access the command modes, use the command line interface (CLI), and describes CLI messages that you might receive. It also describes how to get help, abbreviate commands, use **no** and **default** forms of commands, use command history and how to search and filter the output of **show** and **more** commands.

Chapter 3, “Connecting to System and Assigning IP Address,” describes how to connect system and explains how to assign IP address to be used for network communication.

Chapter 4, “Configuring System Environment,” explains how to configure system environment, manage configurations and check the system. It also describes how to restart your system and make a reservation of system rebooting.

Chapter 5, “Configuring VDSL Feature,” describes how to configure the vdsl feature of each line. It also explains how to upgrade modem image by using automatic and manual methods.

Chapter 6, “Configuring Switch Port Characteristics,” defines the type of Layer 2 and Layer 3 interfaces on the system. It describes the interface command and provides procedures for configuring physical interfaces.

Chapter 7, “Configuring VLAN,” describes how to create and maintain VLANs. It includes information about the VLAN database, VLAN configuration modes. And it describes also how to add interfaces to a VLAN and delete a interface from VLANs.

Chapter 8, “Configuring STP,” describes how to configure the Spanning Tree Protocol (STP) on your system.

Chapter 9, “Configuring DHCP,” describes how to configure the Dynamic Host Configuration Protocol

(DHCP) server and relay agent. It describes also how to configure DHCP snooping features those are used for protected service.

Chapter 10, “Configuring Layer 2 Multicasting,” describes how to configure Internet Group Management Protocol (IGMP) snooping. It includes information about IGMP Snoop Proxy.

Chapter 11, “Configuring IP Multicast Routing,” describes how to configure IP multicast routing. It describes how to use and configure the Internet Group Management Protocol (IGMP) and IGMP Proxy.

Chapter 12, “Configuring filter with ACL,” describes how to configure filters on your system by creating IP access control lists (ACLs).

Chapter 13, “Configuring QoS,” describes how to configure standard quality of service (QoS) on your system. With this feature, you can preferential treatment to certain types traffic.

Chapter 14, “Configuring SNMP,” describes how to configure the Simple Network Management Protocol (SNMP). It describes how to configure community strings, enable trap managers and traps.

Chapter 15, “Configuring System Message Logging,” describes how to configure system message logging. It describes how to change the message display destination device, limit the type of messages sent.

Conventions

This publication uses the following conventions to convey instructions and information. Please be aware of each command to use them correctly.

Notation	Description
abc	Command and keywords are in **boldface** text.
abc	Arguments for which you supply values are in *italic*.
[ ]	Square brackets ([ ]) mean optional elements.
< >	Range of number that you can use.
{ }	Braces ({ }) group required choices, and vertical bar (|) separate the alternative elements.
[{ | }]	Braces and vertical bars within square brackets ([{ | }]) mean a required choice within an optional element.

Interactive examples use these conventions:

abc	Information you enter is in **`boldface screen`** font.
abc	Terminal sessions and system displays are in `screen` font.
< >	Nonprinting characters, such as passwords or tabs, are in angle brackets (< >).

Notes and cautions use these conventions and symbols:

Note Means reader take note. Notes contain helpful suggestions or references to materials not contained in this manual.

Caution	Means reader be careful. In this situation, you might do something that could result equipment damage or loss of data.

Chapter 1 Overview

This chapter describes the feature of VX-MD3024 system. It contains the following sections.

- Features
- Network Configuration Examples

1.1 Features

This section describes the features supported in the VX-MD3024.

Performance

- ✓ Auto-sensing of port speed and auto-negotiation of duplex mode on all switch ports for optimizing bandwidth
- ✓ IEEE 802.3X flow control on all Ethernet ports
- ✓ Per-Port storm control for preventing broadcast, multicast, and unicast storms

Manageability

- ✓ DHCP (Dynamic Host Configuration Protocol), which automatically assigns IP address to clients, accessed to network. You can effectively utilize limited IP source and lower cost to manage network because DHCP server manages all IP addresses from center.
- ✓ DHCP relay agent information (option 82) for subscriber identification and IP address management
- ✓ Support FTP and TFTP for administering software upgrades and configuration information management.
- ✓ Network Time Protocol (NTP) for providing a consistent timestamp to all systems from an external source
- ✓ In-band management access through up to five simultaneous Telnet connections for multiple command-line interface (CLI)-based sessions over the network.
- ✓ In-band management access for up to five simultaneous, encrypted Secure Shell (SSH) connections for multiple CLI-based sessions over the network.
- ✓ In-band management access through Simple Network Management Protocol (SNMP) version 1 and 2c get and set requests.
- ✓ Out-of-band management access through system console port to a directly attached terminal or to a Console Server port which connected with the neighbor system.
- ✓ Port entry guarantees for every subscribers connected with EX-5124B to get the same IP address always. This feature makes you manage your subscribers more efficiently.

Redundancy

- ✓ IEEE 802.1D Spanning Tree Protocol (STP) for redundant backbone connections and loop-free network. STP has these features:
  - Per-VLAN Spanning Tree (PVST) for balancing load across VLANs
  - UplinkFast for fast convergence after a spanning-tree topology change and for achieving load balancing between redundant uplinks.

VLAN (Virtual Local Area Network)

- ✓ Support for up to 1024 VLANs
- ✓ Support for VLAN Ids in the full 1 to 4094 range allowed by the IEEE 802.1Q standard

Security

- ✓ Password protected access to management interfaces for protection against unauthorized configuration changes
- ✓ Access host feature provides limited access from only allowed hosts those are configured with IP address for Telnet, SNMP and SSH.
- ✓ Bridge Protocol Data Unit (BPDU) guard for shutting down a Port Fast-configured port when an invalid configuration occurs.
- ✓ DHCP snooping for limiting and identifying MAC addresses and IP addresses of the stations allowed to access the port.
- ✓ ARP snooping protection for filtering invalid ARP packets those are sent from station which does not have a valid IP address from the DHCP server with valid method.

Quality of Service (QoS) and Class of Service (CoS)

- ✓ Classification
  - IP type-of-service/Differentiated Services Code Point (IP TOS/DSCP) and 802.1P CoS marking priorities on a per-port basis for protecting the performance of mission critical applications
  - TOS/DSCP and 802.1P COS marking based on flow-based packet classification (classification based on information in the MAC, IP, and TCP/UDP headers) for high-performance quality of service at the network edge, allowing for differentiated service levels for different types of network traffic and for prioritizing missioin-critical traffic in the network

- ✓ Policing
  - Policing on a physical interface
  - Traffic-policing policies on the switch port for managing how much of the port bandwidth should be allocated to a specific traffic flow
  - Egress Policing and Scheduling of Egress Queues. Four egress queues on all switch ports. These queues can either be configured with the Weighted Round Robin (WRR) scheduling algorithm or configured with one queue as strict priority queue and the other three queues for WRR. The strict priority queue must be empty before the other three queues are serviced. You can use the strict priority queue for mission-critical and time-sensitive traffic

Layer 3 Support

- ✓ IP routing between VLANs (inter-VLAN routing) for full Layer 3 routing between two or more VLANs, allowing each VLAN to maintain its own autonomous data-link domain
- ✓ Fallback bridging for forwarding non-IP traffic between two or more VLANs
- ✓ Static IP routing for manually building a routing table of network path information
- ✓ Equal-Cost routing for load balancing and redundancy
- ✓ Protocol-Independent Multicast sparse mode (PIM-SM) for multicast routing within the network.

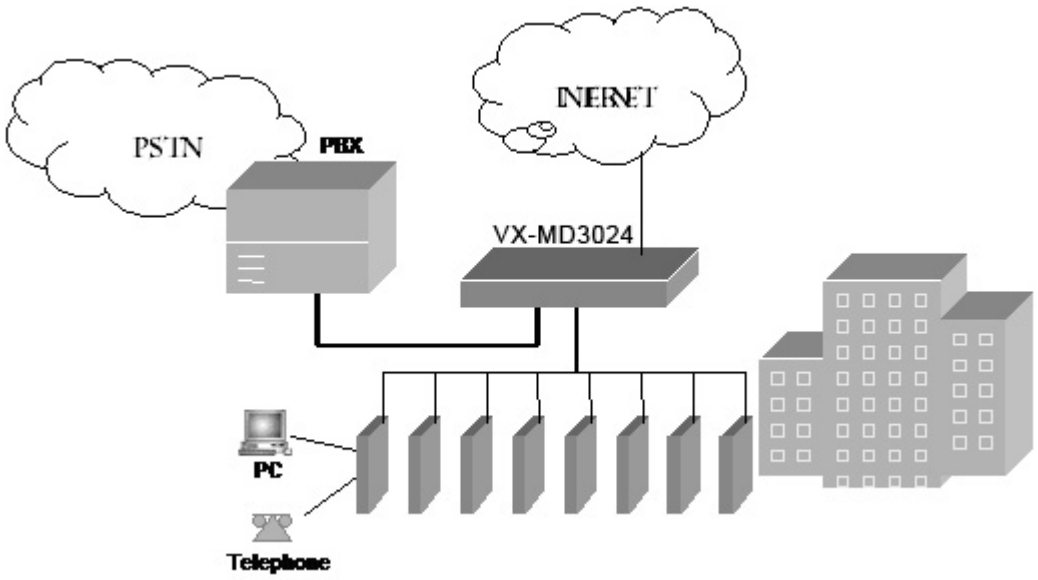
Monitoring

- ✓ System LEDs that provide port and system level status
- ✓ Syslog facility for logging system messages about authentication or authorization errors, resource issues, and time-out events
- ✓ Traffic counters those monitor the ingress or egress packet counters about various packet types.
- ✓ VDSL event reporter and error counters those monitor the status of the line between CO and CPEs and link status

1.2 Network Configuration Examples

VX-MD3024 system using VDSL (Very-high-data rate Digital Subscriber Line) technology for subscribers to be able to use PSTN service and Internet service simultaneously through already distributed telephone lines. It is efficient for network providers or service providers to use EX-5124B by reason of constructing network without new wiring. VX-MD3024 is suitable for hotel, apartment , or building to provide upgraded network service.

The following picture is an example of network construction using VX-MD3024. It is able to provide data service and telephone service.



[Example Configuration]

Chapter 2 Using the Command-Line Interface

This chapter describes CLI (Command Line Interface) that you can use to configure your systems. It contains these sections:

- Command Modes
- Getting Help
- Abbreviating Commands
- Using Command History
- Searching and Filtering Output of show Commands

2.1 Command Modes

VX-MD3024 system's user interface is divided into many different modes. The commands available to you depend on which mode you are currently in. Enter a question mark (?) at the system prompt to obtain a list of commands available for each command mode.

When you login successfully, you begin in user mode, often called user EXEC mode. Only a limited subset of the commands are available in user EXEC mode.

To have access to all commands, you must enter Enable mode, often called privileged EXEC mode. Normally, you must enter a password to enter Enable mode. From this mode, you can enter any Enable mode commands or enter global configuration mode.

You can configure system functions for general system management and SNMP before configuring specific protocol or specific function. From global configuration mode, you can enter interface configuration mode and line configuration mode.

Using the configuration modes (global, interface, and line), you can make changes to the running configuration. If you save the configuration, these commands are stored and used when the system reboots.

The following table describes the main command modes, how to access each one, and the prompt you see in that mode.The examples in the table use the host name VX-MD3024.

[Table: Command Mode Summary]

Mode	Access Method	Prompt
User EXEC	Begin a session with your system	VX-MD3024>
Enable	While in user EXEC mode, enter the **enable** command	VX-MD3024#
Global Configuration	While in Enable mode, enter the **configure** command	VX-MD3024 (config)
VLAN Configuration	While in global configuration mode, enter the **vlan database** command	VX-MD3024 (config-vlan)
Interface Configuration	While in global configuration mode, enter the **interface** command (with a specific interface)	VX-MD3024 (config-if)

Line Configuration	While in global configuration mode, specify a line with **line vty** or **line console** command	VX-MD3024 (config-line)

2.2 Getting Help

You can enter a question mark (?) at the system prompt to display a list of commands available for each command mode. You can also obtain a list of associated keywords and arguments for any command.

The following is the available commands on Enable mode of VX-MD3024 system.

```
VX-MD3024# ?
Exec commands:
  clear          Reset functions
  configure      Enter configuration mode
  console-server  execute console server
  copy           Copy
  debug          Debugging functions (see also 'undebug')
  disable        Turn off privileged mode command
  enable         Turn on privileged mode command
  exit           End current mode and down to previous mode
  help           Description of the interactive help system
  kill           Kill(or terminate) Telnet or SSH Session
  logout         Exit from the EXEC
  no             Negate a command or set its defaults
  ping           Send echo messages
  quit           Exit current mode and down to previous mode
  reload         Halt and perform a cold restart
  remove         Remove file
  restart        Restart routing protocol
  show           Show running system information
  start-shell    Start shell
telnet         Open a telnet connection
(    )
```

Note Question mark (?) will not be seen in the screen and you do not need to press Enter key to display

commands list. The displayed contents may vary depending on OS version.

You can find out commands starting with specific character string. Input the specific string and question mark without space. The following is an example of finding out commands starting with co in Enable mode of VX-MD3024 system.

```
DUT-1# co?
  configure      Enter configuration mode
console-server  execute console server
copy            Copy
```

Also, it is possible to view variables you should input following after commands. After inputting the command you need, make one space and input question mark. The following is an example of viewing variables after the command **copy**. Please note that you must make one space after inputting.

```
DUT-1# copy ?
  config        Configuration file
cpe-os-image  CPE's OS Image
os-image      OS Image
```

2.3 Abbreviating Commands

You have to enter only enough characters for the system to recognize the command as unique. This example shows how to enter the **show running-config** command in Enable mode.

```
DUT-1# sh run
```

2.4 Using Command History

In VX-MD3024 system, you do not have to enter repeated command again. When you need to use

command history, you use up and down arrow key (↑ or ↓). When you press the up arrow key (↑), the latest command you used will be seen one by one.

The following is an example of calling command history after using several commands. After using these commands in order: show clock → configure terminal → interface fe1.1 → exit, press the up arrow key (↑) and then you will see the commands from lastest one: exit → interface fe1.1 → configure terminal → show clock.

```
DUT-1# show clock
2005-11-23 02:02:19 GMT+0900

DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.

DUT-1(config)# interface fe1.1
DUT-1(config-if)# exit

DUT-1# (press the up arrow key, ↑)
↓
DUT-1# exit (arrow key, ↑)
↓
DUT-1# interface fe1.1 (arrow key, ↑)
↓
DUT-1# configure terminal (arrow key, ↑)
↓
DUT-1# show clock
```

Each time you press the up arrow key, only the command is changed on the same line.

2.5 Searching and Filtering Output of show Commands

You can search and filter the output for show commands. This is useful when you need to select through large amounts of output or if you want to exclude output that you don not need to see.

To use this functionality, enter a show or more command followed by the pipe character (|), one of the keywords, **begin, include,** or **exclude**, and an expression that you want to search for or filter out:

command | {**begin** | **include** | **exclude**} regular-expression

Expressions are case sensitive. For example, if you enter **| exclude output**, the lines that contain output are not displayed, but the lines that contain Output are displayed.

This example shows how to include in the output display only lines where the expression state appears:

```
DUT-1# show spanning-tree | include state
%   fe1.1: designated port id 8003 - state Forwarding - priority 128
%   fe1.2: designated port id 8004 - state Forwarding - priority 128
%   fe1.3: designated port id 8005 - state Forwarding - priority 128
%   fe1.4: designated port id 8006 - state Forwarding - priority 128
%   fe1.5: designated port id 8007 - state Forwarding - priority 128
%   fe1.6: designated port id 8008 - state Forwarding - priority 128
%   fe1.7: designated port id 8009 - state Forwarding - priority 128
%   fe1.8: designated port id 800a - state Forwarding - priority 128
%   fe2.1: designated port id 800b - state Forwarding - priority 128
%   fe2.2: designated port id 800c - state Forwarding - priority 128
%   fe2.3: designated port id 800d - state Forwarding - priority 128
%   fe2.4: designated port id 800e - state Forwarding - priority 128
(output truncated)
```

Chapter 3 Connecting System and Assigning IP Address

This chapter explains how to configure password for system connection and IP address for network communication. You can connect to your system and use network service connected to equipments by assigning IP address to interface and activating the interface.

It contains the following sections.

- System Connection
- Assigning IP Address

3.1 System Connection

This section describes how to configure your PC's serial port, and change password for system connection, connect to system through telnet as following order.

- ✓ Configuring Serial Port on your terminal
- ✓ System Login
- ✓ Changing Password
- ✓ Setting the Enable Mode Password
- ✓ Password Encryption
- ✓ Configuring Session Timeouts
- ✓ User Management
- ✓ Telnet Access
- ✓ Managing Telnet Access
- ✓ Displaying Access History
- ✓ Configuring the number of connectable Telnet and SSH session

Configuring Serial Port on your terminal

After installing system, you can connect to the system through the console port. You must follow this configuration in order to connect your PC's seial port to system console port.

Feature	Setting
Baud rate	9600 bps
Data	8 bit
Parity check	None
Stop bit	1 bit

Flow control	none

System Login

After installing the VX-MD3024 system, ensure each port is correctly connected to PC for network and management. And then, turn on the power and boot the system as follow.

When you turn on the system, booting will be automatically started and login prompt will be displayed.

```
U-Boot 1.1.3 (Sep  3 2005 - 16:12:47)
CPU:   AMCC PowerPC 405EP Rev. B at 266.666 MHz (PLB=133, OPB=66, EBC=33
MHz)
      IIC Boot EEPROM enabled
      PCI async ext clock used, internal PCI arbiter enabled
      16 kB I-Cache 16 kB D-Cache
Board: ASH405/EX21xxBD
I2C:   ready
DRAM:  256 MB
FLASH: 32.5 MB
Autobooting in 3 seconds, press "?????" to stop
Loading flash2...
   Verifying Checksum ... OK
   Uncompressing Multi-File Image ... OK
   Loading Ramdisk to 0e21e000, end 0efff17b ... OK
Kernel loading... done.
System initializing... \Done

User Access Verification

username:
```

When you enter login ID at the login prompt, password prompt will be displayed. And enter password to move into Enable mode. By default setting, login ID is configured as "root" and the password is configured as "1234"

```
username: root
password: <1234>
DUT-1>
```

Changing Password

Administrators who can configure and manages can change system password. For thorough security, you would better to change the password whenever necessary.

Beginning in Enable mode, follow these steps to set or change a static enable password.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**password**	Change an existing password
Step 3	Enter the password	Enter the current password and new password to change.
Step 4	**exit**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to change password from 1234 to vdsl.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)# password
Enter Current Password: <1234>
Enter New Password: <vdsl>
Confirm Password: <vdsl>
DUT-1(config)# exit
DUT-1#
```

Note	You can make password from at least 1 characters up to 31 characters. Please avoid similar one withlogin ID.

Note The password you enter will not be seen in the terminal, so please be careful. You need to enter the password twice not to make mistake.

Setting the Enable Mode Password

You can set the Enable mode password that controls access to Enable mode. By default, EX-5124B does not require the Enable mode password for entering the Enable mode.

Beginning in Enable mode, follow these steps to configure enable password.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**enable password**	Define a new password or change an existing password for access to Enable mode.
Step 3	Enter the enable mode password	Enter new password and confirm it.
Step 4	**exit**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to change the Enable mode password to “vdsltest”.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)# enable password
Enter New Password: <vdsltest>
Confirm Password: <vdsltest>
```

Password Encryption

All passwords on the system can be viewed by using the write terminal Enable mode command. If

you have access to Enable mode on the system, you can view all passwords in clear text by default.

You can hide clear-text passwords by storing passwords in an encrypted manner so that anyone entering write terminal commands will not be able to determine the clear-text password.

Beginning in Enable mode, follow these steps to encrypt a user password.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service password-encryption**	Start password encryption mechanism
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

The following example shows how to start password encryption service and displaying the password on the terminal line.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)# service password-encryption
DUT-1(config)# enable password
Enter New Password: <test1>
Confirm Password: <test1>
DUT-1(config)#end
DUT-1#show running-config
!
service password-encryption
!
hostname DUT-1
!
enable password 7 $1$tup5$HdStUVH7YgBpm7dJoqhly1
!
(omitted)
```

Configuring Session Timeouts

The timeout for an unattended telnet session or console session provides an additional security measure. If the telnet line is left unattended in Enable mode, any user can modify the system configuration. You can configure the timeout for console and telnet session separately.

The default timeout for an unattended telnet session is 10 minutes.

Beginning in Enable mode, follow these steps to change the login timeout.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**line console** *line-num* or **line vty** *line-num*	Enter the console-line configuration mode. You must set *line-num* to 0, because the system supports only one Console session. Enter the VTY-line configuration mode. Select line-num to configure telnet session.
Step 3	**exec-timeout** *minutes seconds*	Set the login timeout. The range of minutes is from 0 to 35791. The range of seconds is from 0 to 2147483 If you set the login timeout to 0 0, automatic logout function will be disabled. If you want to disable automatic logout, enter **exec-timeout 0 0** command.
Step 4	**end**	Return to Enable mode
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure disabling automatic logout function for console, and change the timeout for telnet session 0 to 4 to 20 minutes.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#line console 0
DUT-1(config-line)#exec-timeout 0 0
DUT-1(config-line)#exit
DUT-1(config)#line vty 0 4
```

```
DUT-1(config-line)#exec-timeout 20 0
DUT-1(config-line)#end
DUT-1#write memory
[OK]
DUT-1#
```

Note You can access system through up to 3 telnet sessions simultaneously by default. You can change the maximum number of allowed telnet sessions up to 5.

User Management

You can add a new user and remove an existing user. You must configure username and password pairs to add new user. All users start with EXEC mode after login and must pass the authorization procedures with the Enable mode password to move Enable mode.

Beginning in Enable mode, follow these steps to establish a username-based authentication system that requests a login username and password:

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**username** *name*	Enter the user name For name, specify the user ID for entering system.
Step 3	Enter Password	Specify the password for the user and confirm
Step 4	**end**	Return to Enable mode.
Step 5	**show registered-user**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

To disable username authentication for a specific user, use the **no username** *name* global

configuration command.

This example shows how to add a new user whose user ID is 'test_user1' and password is 'tellion1' and verifies the configuration:

```
DUT-1# configure terminal
DUT-1(config)# username test_user1
Enter New Password:<tellion1>
Confirm Password:<tellion1>
DUT-1(config)# exit
DUT-1#show registered-user
************************************************************************
                      Registered User Information
************************************************************************
Username
------------------------------------------------------------------------
root
test_user1
------------------------------------------------------------------------
DUT-1#
```

Note The password you enter will not be seen in the screen, so please be careful not to make mistake.

This example shows how to remove a registered user whose user ID is 'test_user1'.

```
DUT-1# configure terminal
DUT-1(config)# no username test_user1
DUT-1(config)# end
DUT-1# show registered-user
********************************************************************
                      Registered User Information
********************************************************************
Username
------------------------------------------------------------------------
root
------------------------------------------------------------------------
DUT-1#
```

Telnet Access

In order to connect to system by telnet at remote place, use the following commands in global configuration mode.

Command	Description
telnet *destination*	Connects with IP address of another system.
telnet *destination port-number*	Connects with specified port of another port

Managing Telnet Access

You can display users connected from remote and make some of them disconnected, as you want. In order to display telnet users connected from remote place, before disconnecting a user, use the following command in Enable mode.

Command	Description
show login-user	Show users connected.

This example shows how to display login users.

```
DUT-1# show login-user
ID    User             Type          Host         Elapsed
-----------------------------------------------------------------
695     root             Console    console           01:15:27
826     test_user        Telnet     210.121.174.215   00:00:14
-----------------------------------------------------------------
```

You can disconnect a user connected from a remote location by using session ID which can be find with show login-user command in Enable mode.

In order to disconnect a user connected with telnet, use the following command in Enable mode.

Command	Description
kill session *session-id*	Disconnect a user with *session-id*.

This example shows how to disconnect the remote connect user whose session ID is 826.

```
DUT-1# kill session 826
DUT-1#
```

Displaying Access History

You can show the history about accessing your system. Use the following command to display history of system access in Enable mode. In order to display the system access history, you must configure system message logging to store the system access history information. You can refer to Chapter 15, "Configuring System Message Logging" for more detailed information.

Command	Description
show log buffer login-history	Show the login history information

This example shows how to display the login history information.

```
DUT-1# show log buffer user-session
max-entry-size : 1000, current-entry-count : 607
Nov 23 11:21:47 <6> NSM: [CLI][LOGOUT]: user : root, remote-host : 210.121.174.215,
type : vty
Nov 23 11:21:42 <6> NSM: [CLI][LOGOUT]: user : test_user, remote-host:
210.121.174.215, type : vty
Nov 23 11:21:26 <6> NSM: [CLI][LOGIN]: user : test_user, remote-
host :210.121.174.215, type : vty
```

```
Nov 23 11:20:54 <6> NSM: [CLI][LOGIN]: user : root, remote-host : 210.121.174.215,
type : vty
```

Note You can show the login history only, when you configure the logging process to store the information first.

Configuring the number of connectable Telnet and SSH session

You can configure the maximum number of telnet sessions. By default, the maximum number of telnet session is three, thus the only VTY-line 0 to 2 are active, and VTY-line 3 and VTY-line 4 are disable. And all of SSH-line are disable.

Beginning in Enable mode, follow these steps to configure the number of maximum connectable Telnet sessions and SSH sessions.

	Command	Descriptioin
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**line vty** *start-line end-line* or **line ssh** *start-line end-line*	Enter the VTY-line configuration mode. Specify the range of line number with *start-line* and *end-line* Enter the SSH-line configuration mode. Specify the range of line number with *start-line* and *end-line*
Step 3	**end**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

If you enter **line vty** *0 3* line configuration command, VTY-line 0 to 3 will be activate. And enter **line ssh** *0 2* line configuration command to activate SSH-line 0 to 2. After enter above commands, you can connect with four telnet (VTY-line 0 to 3) and three SSH (SSH-line 0 to 2) sessions simultaneously.

You can disable the already activated line with **no line vty** *2 3* command or **no line ssh** *2* line configuration command, if you want to reduce the maximum number of connectable Telnet or SSH

sessions.

This example shows how to configure the maximum number of telnet sessions to 5, and SSH sessions to 3.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)# line vty 0 4
DUT-1(config-line)# exit
DUT-1(config)# line ssh 0 2
DUT-1(config-line)# end
DUT-1# write memory
[OK]
DUT-1#
```

This example verifies the above configuration result.

```
DUT-1# show running-config
(omitted)
line console 0
!
line vty 0 4
!
line ssh 0 2
!
(omitted)
```

This example shows how to reduce the maximum number of telnet sessions to 3 and ssh sessions to 2 from the above configuration.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no line vty 3 4
DUT-1(config)#no line ssh 2
DUT-1(config)#exit
DUT-1#write
```

```
[OK]
DUT-1#
```

This example verifies the configuration results after above configuration.

```
DUT-1# show running-config
(omitted)
line console 0
!
line vty 0 2
!
line ssh 0 1
!
(omitted)
```

3.2 Assigning IP Address

If the VX-MD3024 system operates in Layer 2 switching mode, it uses only the data's MAC address to determine where traffic need to come from and which ports should receive the data. Systems do not need IP addresses to transmit packets. However if you want to access to VX-MD3024 system from remote place with TCP/IP through SNMP or telnet, it requires IP address.

Note By default, VX-MD3024 system is configured to Layer 2 mode and all of physical ports included in VLAN1.1 interface.

This section describes how to activate the physical port and assign IP address.

- ✓ Configuring the Layer of each Interface
- ✓ Assigning IP address to Layer 3 interface
- ✓ Configuring Static Routes and Default router

Configuring the Layer of each Interfaces

As a default setting, all physical ports of VX-MD3024 system are configured Layer 2 mode. And all physical ports are included in VLAN1.1 Layer 3 interface. If you want to use VX-MD3024 system to Layer 2 mode, you just assign IP address to VLAN1.1 Layer 3 interface.

But, if you want to use VX-MD3024 system to Layer 3 mode, you must create new VLAN and assign some physical ports to the new VDSL. And assign a IP address to the created VLAN.

If you want to more detailed information about configuring VLAN, you can refer chapter 7, "Configuring VLAN".

Assign IP address of Layer 3 Interface

Beginning in Enable mode, follow these steps to assign IP address to Layer 3 interface.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *if-name*	Enter interface configuration mode. Specify the layer 3 interface to assign IP address.
Step 3	**ip address** *ip-address/subnet-mask*	Assign IP address and subnet mask to the layer 3 interface.
Step 4	**end**	Return to Enable mode.
Step 5	**show ip interface brief**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to assign IP address 192.168.100.10 to the VLAN1.1 interface and verify.

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.10
DUT-1(config-if)#ip address 192.168.100.10/24
DUT-1(config-if)#end
DUT-1#show ip interface brief
Interface           IP-Address     Status             Protocol
lo                  127.0.0.1      up                 up
vlan1.1             192.168.100.10 up                 up
DUT-1#write memory
[OK]
DUT-1#
```

DHCP Client

You can assign an IP address of a Layer 3 interface manually. You can use the DHCP client function to assign an IP address to the specified Layer 3 interface.

Beginning in Privileged EXEC mode, follow these steps to configure a Layer 3 interface to be assigned IP address using DHCP client.

	Command	Description
Step 1	**configure terminal**	Enter the global configuration mode.
Step 2	**interface** *interface-id*	Enter interface configuration mode, and enter the Layer 3 interface to configure. The interface must be a Layer 3 interface.
Step 3	**ip address dhcp**	Configure the Layer 3 interface gets IP address automatically with DHCP client function.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

Configuring Static Routes and Default router

IP routing provided by VX-MD3024 system allows you to exchange traffic between different networks and VLAN groups.

Specially, when you want to interconnect a bridged network with a routed network or another bridged network, the layer 3 switching feature enables the switch to act as a true router. Configuring static routes enables your system to route traffic over the network. Static routes are user-defined routes that cause packets moving between a source and a destination to take a specified path. Static route entries consists of the destination IP network address, the IP address of the next hop router.

Beginning in Enable mode, follow these steps to configure static routes.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip route** *ip-address/subnet-mask {ip-address | interface-name}*	Establish static route. Specify IP address range of the remote network and the interface or IP address of the next-hop router.
Step 3	**end**	Return to Enable mode.
Step 4	**show ip route** *{ip-address | ip-address/M | bgp | connected | database | isis | kernel | ospf | rip | static}*	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure static routes on the system for the two nodes those are not directly connected to.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip route 100.1.1.0/24 192.168.40.254
DUT-1(config)#ip route 100.2.2.0/24 192.168.40.254
DUT-1(config)#end
DUT-1#show ip route
Codes: K - kernel, C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
```

```
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
      * - candidate default

Gateway of last resort is 192.168.40.254 to network 0.0.0.0

S      100.1.1.0/24 [1/0] via 192.168.40.254, ge1
S      100.2.2.0/24 [1/0] via 192.168.40.254, ge1
C      192.168.40.0/24 is directly connected, ge1
C      192.168.101.0/24 is directly connected, vlan1.1
DUT-1#write
[OK]
DUT-1#
```

The following example shows how to configure the default network 0.0.0.0/0 through a default gateway 192.168.40.254. The default route appears in the gateway display of the **show ip route** command.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip route 0.0.0.0/0 192.168.40.254
DUT-1(config)#end
DUT-1#write
[OK]
DUT-1#
```

Use this command in Enable mode to remove the configured static route.

Command	Description
no ip route *{ip-address | ip-address/M} [{ip-address | interface-name}]*	Remove static route.

This example shows how to remove the static route. You can specify only destination IP address

range to remove the static route.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no ip route 100.1.1.0/24 192.168.40.254
DUT-1(config)#no ip route 100.2.2.0/24
DUT-1(config)#end
DUT-1#write
[OK]
DUT-1#
```

Chapter 4 Administrating System

This chapter describes how to configure system environment such as configuring host name and setting date and time and so on. This chapter contains following sections

- Configuring System Environment
- Managing Configurations
- Displaying System Information
- Configuring Ping Monitoring Function
- Restart System

4.1 Configuration System Environment

This section describes the following items:

- ✓ Configuring Date and Time
- ✓ Configuring NTP (Network Time Protocol)
- ✓ Configuring Time-Zone
- ✓ Configuring Host Name
- ✓ Configuring Default TTL
- ✓ Managing the Output Redirection File

Configuring Date and Time

You can configure date and time on your system.

Beginning in Enable mode, follow these steps to configure date and time on your system.

	Command	**Descriptioin**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**clock** *year month day hh mm ss*	Configure date and time. For *year*, specify the year. The range is 1999 to 2999. For *month*, specify the month. The range is 1 to 12. For *day*, specify the day. The range is 1 to 31. For *hh*, specify the hour. The range is 0 to 23. For *mm*, specify the minute. The range is 0 to 59 For *ss*, specify the second. The range is 0 to 59.
Step 3	**exit**	Return to enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to set the system clock to 1:41 p.m. on November 24, 2005:

```
DUT-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)# clock 2005 11 24 13 41 00
DUT-1(config)# exit
DUT-1#
```

To display the time and date configuration, use the **show clock** command in Enable mode. This example shows how to display the system clock.

```
DUT-1# show clock
2005-11-24 13:46:10 GMT+0900
```

Configuring Network Time Protocol (NTP)

NTP (Network Time Protocol) can be used to configure your systems to 1/1000 second to guarantee the exact time on networks. The System and NTP server constantly transmit the message each other to converge the correct time. It is very important to configure exact time to the system so that the system operates properly. The details about NTP will be given at STD and RFC 1119.

Beginning in Enable mode, follow these steps to configure NTP on your system.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ntp server** *ip-address*	Specify NTP server's IP address. You can configure several NTP server by repeating this command.
Step 3	**ntp query-interval** *<1-43200>*	Configure the period try to send NTP packet to the NTP server. The range is 1 to 43200, and the unit is minutes.
Step 4	**service ntp**	Enable NTP function.
Step 5	**exit**	Return to enable mode.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the system to synchronize its system clock with the clock of the NTP server at IP address 203.255.112.96 and configure the period to synchronize to 10 minutes. And enable NTP function.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ntp server 203.255.112.96
DUT-1(config)#ntp query-interval 10
DUT-1(config)#service ntp
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#
```

To display the NTP configuration on your system, use the **show ntp** command in Enable mode. This example shows how to display NTP server configuration.

```
DUT-1#show ntp
+ NTP Service       : Enabled
+ NTP Query Interval : 10 minutes
+ NTP Server List   :
               203.255.112.96
DUT-1#
```

Configuring Time-Zone

You can configure Time-zone to your system. You must check Time-zone that you can configure..

The following table shows the kinds of Time-zone, which can configure to the system and a main country or area, belong to the Time-zone.

Time Zone	Country	Time Zone	Country
GMT-12	Eniwetok	**GMT+12**	Wellington
GMT-11	Samoa	**GMT+11**	Okhotsk

GMT-10	Hawaii, Honolulu	**GMT+10**	Sydney, Melbourne
GMT-9	Alaska	**GMT+9**	Seoul, Tokyo
GMT-8	LA, Seattle	**GMT+8**	Hong Kong, Peking
GMT-7	Denver	**GMT+7**	Bangkok, Singapore
GMT-6	Chicago, Dallas	**GMT+6**	Rangoon
GMT-5	New York, Miami	**GMT+5**	New Dehli
GMT-4	George Town	**GMT+4**	Teheran
GMT-3	Rio De Janeiro	**GMT+3**	Moscow
GMT-2	Maryland	**GMT+2**	Cairo, Athens
GMT-1	Azones	**GMT+1**	Berlin, Rome
GMT+0	London, Lisbon		

Beginning in Enable mode, follow these steps to configure Time-zone.

	Command	**Description**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**clock time-zone {gmt-minus|gmt-plus}** *hour*	Set the time zone. For *hour*, enters the hour offset from UTC. The range is 0 to 12.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

Caution When you set the time zone on your system, the time and date of the system will be changed also. Therefore you must set time and date on your system again, after setting time zone.

Note By default, the time zone of the system is set to GMT+9.

This example shows how to configure time zone as Seoul and displaying the system clock.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#clock time-zone gmt-plus 9
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#show clock
2005-11-24 14:37:21 GMT+0900
DUT-1#
```

Configuring Host Name

Host name displayed on prompt is necessary to distinguish each device connected to network. In order to configure or change host name of switch, use the **hostname** command in global configuration mode.

Beginning in Enable mode, follow these steps to set the hostname of your system.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**hostname** *name*	Manually configure your system name. The default setting is VX-MD3024.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

When you set the system name, it is also used as the system prompt. To return to the default hostname, use the **no hostname** command in global configuration mode.

This example shows how to set host name to *DSLAM*.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#hostname DSLAM
```

```
DSLAM(config)#exit
DSLAM#write memory
[OK]
DSLAM#
```

Configuring Default TTL

The default TTL value of the system is 64 generally. Thus the TTL value of the IP packets sent from your system is 64 when you use ping or telnet on your system. But sometimes you should set the larger TTL value according to the network configuration.

After you set the default TTL value to 128, the TTL of all packets sent from your system is set to 128. Beginning in privileged EXEC mode, follow these steps to configure the default TTL value of your system.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip ttl** *ttl-value*	Specify the TTL value to configure. The default value is 64 and the range is 1 to 255.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show running-config**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

You can use the **show ip ttl** command in Privileged EXEC mode to display the TTL value configured in your system.

This example shows how to set the TTL value to 128.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip ttl 128
DUT-1(config)#end
DUT-1#show running-config
(output truncated)
clock time-zone gmt-plus 9
```

```
!
ip ttl 128
!
(output truncated)
DUT-1#write memory
[OK]
DUT-1#
```

Managing the Output Redirection File

You can use the redirection keyword to store the output to the specified file when you enter a command. You can display the output files generated by using redirection function and remove the files. And you can transfer the redirection files to the FTP or TFTP server using the **copy** command.

Use the following Privileged EXEC commands to display, remove and copy the output file generated by using redirection.

Command	Description
show redirect-output	Display the redirection file lists stored in your system.
show redirect-output *file-name*	Display the contents of the specified redirection file.
remove redirect-output *file-name*	Delete the specified redirection file.
copy redirect-output *src-file-name* **tftp** *ip-address dest-file-name*	Transfer the specified redirection file to the TFTP server.
copy redirect-output *src-file-name* **tftp** *ip-address user-id passwd dest-path*	Transfer the specified redirection file to the FTP server.

4.2 Managing Configurations

You can check whether the configuration settings you entered are valid or not, and save them in the configuration file. This section contains the following functions.

- ✓ Checking the Running Configuration

- ✓ Saving the Running Configuration
- ✓ Clearing the Startup Configuration
- ✓ Save the Configuration to the Backup Configuration
- ✓ Managing the Backup Configuration File
- ✓ Copying Configuration Files by Using TFTP and FTP

Checking the Running Configuration

You can check the configuration settings you entered or changes you made by entering Enable mode.

This example shows the running configuration.

```
DUT-1#show running-config
!
service password-encryption
!
hostname DUT-1
!
username root password 8 4D1rxNdkiu1Eg
(output truncated)

line console 0
 exec-timeout 0 0
line vty 0 2
 exec-timeout 0 0
line ssh 0 1
!
end
```

Saving the Running Configuration

After you change system configuration, you must store it to the startup configuration in Flash memory.

If you do not store the changed configuration, the changed configuration will be lost when you restart

your system.

To store the configuration or changes you have made to your startup configuration in Flash memory, enter the following command in Enable mode.

Command	Description
write memory	Save your entries in the configuration file.
copy config running-config startup-config	Save your entries in the configuration file.

Two commands described the above table do the same function. This example shows how to save the changed configuration in the configuration file.

```
TELLION#write memory
[OK]
TELLION#
```

Clearing the Startup Configuration

You can remove the configuration changes one by one. Occasionally, you want to clear all of the configuration you have changed. To clear the configuration file of your system, use the following command in Enable mode.

Command	Description
copy config factory-default-config startup-config	clear the configuration file and make new configuration file with the factory default mode.

This example shows how to clear your configuration.

```
DUT-1#copy config factory-default-config startup-config
```

```
OK..
startup-config would be applied AFTER system reboot.
DUT-1 #
```

Note After you clear the startup configuration file, to operate with the cleared configuration, you must reboot your system.

You may also want to keep the configuration information that is requested for communication with system, even though you clear the configuration information on your system. VX-MD3024 system supports the default configuration whose contents are same with the one of the factory default configuration except the IP address assigned to Layer 3 interfaces, VLAN and static routing information.

To clear the configuration except IP address, VLAN, and routing information, use the following command in Enable mode.

Command	Description
copy config default-config startup-config	Clear the configuration except the IP addresses, VLAN and static routing information.

This example shows how to clear the configuration except IP address assigned to the interfaces, VLAN, and routing information on the system.

```
DUT-1#copy config default-config startup-config
OK..
startup-config would be applied AFTER system reboot.
DUT-1 #
```

Note After you copy the default-config file to the startup-config file, you must restart your system for the cleared configuration to be applied on your system.

Save the Configuration to the Backup Configuration

You can save the running configuration to the backup configuration file. You can also use the backup configuration file to recover system, when the configuration of your system is corrupted. Also you can use the backup configuration file to configure other system easily.

To save the running configuration to the backup configuration file, use the following command in Enable mode.

Command	Description
copy config running-config backup-config *name*	Save the running configuration to a backup configuration file. For *name*, Enter the name of the backup configuration file you save.

This example shows how to save your configuration to the backup configuration file.

```
DUT-1#copy config running-config backup-config tellion.conf
DUT-1 #
```

You can recover the configuration by using the backup configuration file that was saved already. To recover the configuration file with the backup configuration, use the following command in Enable mode.

Command	Description
copy config backup-config *name* **startup-config**	Restore the configuration with the backup configuration file whose file name is *name*.

This example shows how to store the configuration to the backup configuration file named tellion.conf.

```
DUT-1#copy config backup-config tellion.conf startup-config
OK..
startup-config would be applied AFTER system reboot.
DUT-1 #
```

Managing the Backup Configuration File

You can copy, erase and display the stored backup configuration files.

To copy the backup configuration file to another backup file, use the following command in Enable mode.

Command	Description
copy config backup-config *name1* **backup-config** *name2*	Copy the backup configuration file *name1* to *name 2*.

To delete the backup configuration file, use the following command in Enable mode.

Command	Description
remove backup-config *name*	Erase the backup configuration file named *name*.

To display the backup configuration files, use the following command in Enable mode.

Command	Description
show backup-config	Display the backup configuration file list.

This example shows how to copy, delete and display the backup configuration file. The first statement copy the backup configuration file named *tellion.conf* to the other backup configuration file named *test.conf*. The second statement displays the backup configuration file lists and the third statement deletes the backup configuration file named test.conf.

```
DUT-1#copy config backup-config tellion.conf backup-config test.conf
DUT-1#show backup-config
Filename                                  CreationTime        Filesize
-------------------------------------------------------------------------
test.conf                                2006-08-23 09:54:02     2914
tellion.conf                             2006-08-23 09:54:16     2914
DUT-1#remove backup-config test.conf
DUT-1#
```

Copying Configuration Files by Using FTP and TFTP

You can configure the system by using configuration files you create or download from a TFTP or a FTP server. You can upload the backup configuration files to a TFTP server or a FTP server for storage.

To download or upload a configuration file by using TFTP, use the following command in Enable mode.

Command	Description
copy config backup-config *name1* **ftp** *ip-address user-id passwd name2*	Uploads the backup configuration file to a FTP server.
copy config backup-config *name1* **tftp** *ip-address name2*	Uploads the backup configuration file to a TFTP server.
copy config ftp *ip-address user-id passwd name1* **backup-config** *name2*	Downloads a configuration file from a FTP server.
copy config tftp *ip-address name1* **backup-config** *name2*	Downloads a configuration file from a TFTP server.

Before you begin to download or upload the backup configuration file using FTP or TFTP, you must check the FTP server or TFTP server is properly configured. You must check the system has a route to the TFTP or FTP server.

This example shows how to upload the backup configuration file named *tellion.conf* to the TFTP server whose IP address is 192.168.100.51 and download the backup configuration file named *test.conf* from

the FTP server whose IP address is 192.168.100.51.

```
DUT-1#copy config backup-config tellion.conf tftp 192.168.100.51
tellion.conf
DUT-1#copy config ftp 192.168.100.51 tellion tellion test.conf backup-
config test.conf
DUT-1#
```

Note When you download or upload a configuration file by using TFTP or FTP, you can use only backup configuration file. You cannot copy the download configuration to the running configuration file or the startup configuration file.

4.3 Checking System

When there is any problem in system, the issue and its solution must be determined immediately. Always check the system to prevent issues from occuring. Administrators should not only be aware of the system status but should also check if configurations are correctly changed. This section includes the following functions with command.

- ✓ Checking Network Connection
- ✓ Tracing Packet Route
- ✓ Dump Packet
- ✓ Managing MAC Table
- ✓ Configuring Ageing Time
- ✓ Managing ARP Table
- ✓ Displaying System Uptime
- ✓ Displaying Average CPU Utilization
- ✓ Displaying Memory Utilization

- ✓ Displaying Version of System Image
- ✓ Displaying Information of Installed System Image
- ✓ Displaying System Environment Status

Checking Network Connection

You can use the **ping** command in Enable mode to check if your system is correctly connected to the network.

In order to do ping test for checking network connection to the peer system, use the following command in Enable mode.

Command	Description
ping *[ip-address]*	Sends an ICMP echo message to a designated IP address for testing connectivity.

The following is an example of a ping test to check the network connection with 192.168.10.2.

```
DUT-1#ping 192.168.10.2
PING 192.168.10.2 (192.168.10.2) from 192.168.40.201 : 56(84) bytes of data.
64 bytes from 192.168.10.2: icmp_seq=1 ttl=254 time=0.902 ms
64 bytes from 192.168.10.2: icmp_seq=2 ttl=254 time=0.770 ms
64 bytes from 192.168.10.2: icmp_seq=3 ttl=254 time=0.777 ms
64 bytes from 192.168.10.2: icmp_seq=4 ttl=254 time=0.786 ms

--- 192.168.10.2 ping statistics ---
4 packets transmitted, 4 received, 0% loss, time 3022ms
rtt min/avg/max/mdev = 0.770/0.808/0.902/0.064 ms
```

Note If you use ping command, the system send ping message continuously. To stop the ping test, you must enter Ctrl-C Key.

Extended Ping

When you enter the **ping** command, your system tries to send the ICMP Echo messages continuously until you enter the Ctrl + C Key in the previous TOS version. You should not use the **ping** command in the input file to be used to execute automatic CLI from this weak point.

When you enter the ping command in TOS 2.0.8, your system tries to send ICMP Echo messages just 4 times and finishes the command basically. You can configure also the count to try to send ICMP Echo messages and configure the size of the ICMP Echo messages to be sent.

When you use the **ping** command to confirm the connection status between your system and the other system, use the following command options in Privileged EXEC mode.

Command	Description
ping *ip-address*	Try to send ICMP Echo messages 4 times to the specified IP address.
ping *ip-address* **count** *count*	Try to send ICMP Echo messages the number of specified times. For count, specify the number of times to try to send.
ping *ip-address* **size** *size*	Try to send ICMP messages of which length is specified 4 times. For size, specify the length of the ICMP Echo message to be sent. If you do not specify the size, the length of the ICMP Echo message would be 56 by default. The range is 0 to 65507.
ping *ip-address* **count** *count* **size** *size*	Specify the number of times to try to send and the size of the ICMP Echo messages For count, specify the number of times to try to send. For size, specify the length of the ICMP Echo message to be sent. If you do not specify the size, the length of the ICMP Echo message would be 56 by default. The range is 0 to 65507.

Tracing Packet Route

You can discover the routes that packets will actually take when traveling to their destinations. To do this, the traceroute command sends probe packets and displays the round-trip time for each node. If the timer goes off before a response comes in, an asterisk (*) is printed on the screen.

To trace the route, use the following command in Enable mode.

Command	Description
traceroute *ip-address*	Traces packet routes through the network with input IP address.

The following is an example of tracing packet route sent to 192.168.10.2.

```
DUT-1#traceroute 192.168.10.2
traceroute to 192.168.10.2 (192.168.10.2), 30 hops max, 40 byte packets
 1  192.168.40.254 (192.168.40.254)  1.019 ms  1.788 ms  0.964 ms
 2  192.168.10.2 (192.168.10.2)  1.34 ms *  1.128 ms
DUT-1#
```

Dump Packet

(1) Dump the Header of Packets

You can dump the header of packets sent from your system and received on your system using the dump-packet command in Privileged EXEC mode. Use the following Privileged EXEC commands to dump the packets on interfaces of your system.

Command	Description
dump-packet {*interface-name* | **any**}	Dump the packets received on the specified interface or sent to the interface. For *interface-name*, specify the interface dumping packets. You can specify Layer 2 interface or Layer 3 interface. If you use **any** keyword instead of interface name, you can dump all packets on every interfaces.

dump-packet {*interface-name* | **any**} ethernet {mac-address | **any** }	Dump the packets of which the source MAC address is same with specified MAC address on the specified interface. If you set **any** keyword instead of a specific MAC address, it means the MAC address field is don't care.
dump-packet {*interface-name* | **any**} ethernet {src-mac-address | **any** } {dest-mac-address | **any** }	Dump the packets of which the source MAC address is same with *src-mac-address* and the destination MAC address is same with *dest-mac-address* also on the specified interface. If you set **any** keyword instead of a specific MAC address, it means the MAC address field is don't care.
dump-packet {*interface-name* | **any**} **{arp | dhcp | icmp | igmp | ip | multicast}** {src-ip-address | **any** }	Dump the ARP, DHCP, ICMP, IGMP or IP packets of which the source IP address is same with *src-ip-address* on the specified If you set **any** keyword instead of a specific IP address, it means the IP address field is don't care.interface.
dump-packet {*interface-name* | **any**} **{arp | dhcp | icmp | igmp | ip | multicast}** {src-ip-address | **any** } {dest-ip-address | **any** }	Dump the ARP, DHCP, ICMP, IGMP or IP packets of which the source IP address is same with *src-ip-address* and the destination IP address is same with *dest-ip-address* on the specified interface. If you set **any** keyword instead of a specific IP address, it means the IP address field is don't care.
dump-packet {*interface-name* | **any**} **{tcp | udp} ip** { src-ip-address | **any** }	Dump the TCP or UDP packets of which the source IP address is same with src-ip-address on specified interface. If you set **any** keyword instead of a specific IP address, it means the IP address field is don't care.
dump-packet {*interface-name* | **any**} **{tcp | udp} ip** { src-ip-address | **any** } { dest-ip-address | **any** }	Dump the TCP or UDP packets of which the source IP address is same with src-ip-address and the destination IP address is same with dest-ip-address on specified interface. If you set **any** keyword instead of a specific IP address, it means the IP address field is don't care.
dump-packet {*interface-name* | **any**} **{tcp | udp} ip** { src-ip-address | **any** } { dest-ip-address | **any** } **portnum** {port-number | **any** }	Dump the TCP or UDP packets of which the source IP address and the destination IP address is same with specified IP addresses and the source port number is same with specified one. If you set **any** keyword instead of a specific IP address, it means the IP address field is don't care.
dump-packet {*interface-name* | **any**} **{tcp | udp} ip** { src-ip-address | **any** } { dest-ip-	Dump the TCP or UDP packets of which the source IP address and the destination IP address is same with specified IP

address | **any** } **portnum** {port-number | **any** } {port-number | **any** }	addresses and the source port number and the destination number are same with specified numbers. If you set **any** keyword instead of a specific IP address, it means the IP address field is don't care.
dump-packet {*interface-name* | **any**} **{tcp | udp} portnum** {port-number | **any** }	Dump the UDP or TCP packets of which the source port number is same with the specified one.
dump-packet {*interface-name* | **any**} **{tcp | udp} portnum** {port-number | **any** } {port-number | **any** }	Dump the UDP or TCP packets of which the source port number and the destination number port are same with the specified ports.

(2) Control the Display ing Ethernet Header

Before you use the **dump-packet** command to dump the packets matched in the condition you specified, you can configure that the Ethernet header of the packets to dump could be displayed. Beginning in Privileged EXEC mode, follow these steps to display the Ethernet header of the dumping packets also

	Command	**Description**
Step 1	**configure terminal**	Enter global configuration.
Step 2	**dump-packet include-ethernet-header**	Configure the option of the **dump-packet** command to display Ethernet header of dumping packets. You can not show the Ethernet header of packets to dump by default.
Step 3	**end**	Return to Privileged EXEC.
Step 4	**show dump-packet**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

(3) Control the Display ing of Raw D ata

You can dump the packets with the raw packet data. Beginning the Privileged EXEC mode, follow these steps to configure whether the raw data will be displayed or not

	Command	Description
Step 1	**configure terminal**	Enter global configuration.
Step 2	**dump-packet raw-data** *display-length*	Configure the option of the **dump-packet** command to display raw data of the dumping packets. For display-length, specify the length of raw data to display.
Step 3	**end**	Return to Privileged EXEC.
Step 4	**show dump-packet**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

If you don't want to show the raw data of the packets to be dumped, use the **no dump-packet raw-data** command to disable dumping raw data function.

(4) Configuring the Number of Packets to Dump

When you run the **dump-packet** command, the system dumps the number of packets configured and it would print out a prompt and return to waiting status to process the next command.

Beginning in Privileged EXEC mode, follow these steps to configure the number of packets to dump when you run the **dump-packet** command.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**dump-packet count** *number*	Configure the number of packets to dump when you run the **dump-packet** command. For *number*, specify the number of packets to dump. The default value is 1024 and the range is 1 to 8192.
Step 3	**end**	Return to privileged EXEC mode.
Step 4	**show dump-packet**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

Managing MAC Table

You can display the MAC table information to find a system that has a specific MAC address is connected to which port.

To display the MAC address table, use the following command in Enable mode.

Command	Description
show bridge	Displays MAC table.

The following is an example of displaying MAC table.

```
DUT-1#show bridge
bridge      VLAN port     MAC          Discard   Type
1           10   ge1      0000.f076.ccc0   N     Dynamic
1           10   ge1      0001.0257.2a49   N     Dynamic
1           10   ge1      0001.028c.5ee9   N     Dynamic
1           10   ge1      0001.0297.6915   N     Dynamic
1           10   ge1      0002.4427.1af9   N     Dynamic
(output truncated)
DUT-1#
```

MAC addresses are recorded in MAC table can be divided to kinds of type. One type is dynamic MAC address which is recorded in MAC address automatically by using source MAC address passing the port. And the other is static MAC address that is recorded in MAC table manually. A static MAC address is not deleted until you delete the MAC address manually. The static MAC address remains in MAC table on your system after rebooting it.

Beginning in Enable mode, follow these steps to add a static MAC address on your system.

	Command	Description
Step 1	**configure terminal**	Enter global configuration command

Step 2	**bridge 1 address** *MAC-Address* **{forward | discard}** *port* [**vlan** *vlan-id*]	Add a static MAC address. For **{forward | discard}**, specify filtering type. discard means the packet whose source MAC address is the MAC address will be discarded. For *MAC-Address*, specify the source MAC address to add For vlan, specify the VLAN ID. If you don't enter **vlan** *vlan-id*, the vlan-id is the default vlan.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to add a static MAC address, and display MAC table.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#bridge 1 address 000e.dc31.0011 forward fe1.1
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#show bridge
bridge      VLAN port     MAC          Discard   Type
1           1    fe1.1    000e.dc31.0011    N      Static
1           10   ge1      0000.f076.ccc0    N      Dynamic
1           10   ge1      0001.0257.2a49    N      Dynamic
(output truncated!)

DUT-1#
```

To remove a MAC address in the MAC table, use the following command in Enable mode.

Command	Description
clear mac address-table {dynamic | static} bridge *bridge-id*	Delete all dynamic or static MAC addresses in a specified bridge-id.
clear mac address-table {dynamic | static} interface *interface-id* **bridge** *bridge-id*	Delete all dynamic or static MAC addresses in a specified interface.

clear mac address-table {dynamic | static} vlan *vlan-id* **bridge** *bridge-id*	Delete all dynamic or static MAC addresses in a specified VLAN.
clear mac address-table {dynamic | multicast | static} address *MAC-address* ***bridge*** *bridge-id*	Delete a specified MAC address.

This example shows how to delete MAC addresses in MAC table.

```
DUT-1#clear mac address-table static address 000e.dc31.0011 bridge 1
DUT-1#clear mac address-table dynamic interface fe1.1 bridge 1
DUT-1#clear mac address-table static vlan 10 bridge 1
DUT-1#clear mac address-table dynamic bridge 1
DUT-1#
```

Configuring Ageing Time

The system records MAC table to prevent broadcast packets from transmitting. And unnecessary MAC address that does not response during specified time is deleted from the MAC table automatically. The specified time is called aging time.

Beginning in Enable mode, follow these steps to configure aging time.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**bridge 1 ageing-time** *seconds*	Specify the aging time. The default value is 300 seconds. The range is 10 to 1000000.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the ageing time to 800 seconds.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
DUT-1(config)# bridge 1 ageing-time 800
DUT-1(config)# exit
DUT-1#write memory
[OK]
DUT-1#
```

Managing ARP Table

You can add ARP entries to the ARP table, and remove a entry from the ARP table on your system.

Beginning in Enable mode, follow these steps to add an ARP entry (IP address and MAC address) to ARP table.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**arp** *ip-address mac-address*	Add an ARP entry which is composed of a IP Address and a MAC address manually. For *ip-address*, specify IP address. For *mac-address*, specify MAC address.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to add an ARP entry whose IP address is 192.168.40.101 and MAC address is 00:0E:DC:31:00:AA.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#arp 192.168.40.101 00:0e:dc:31:00:aa
DUT-1(config)#exit
DUT-1#write memory
DUT-1#
```

Beginning in Enable mode, follow these steps to delete an ARP entry from the ARP table.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**no arp** *ip-address*	Delete an ARP entry whose IP address is *ip-address*. For ip-address, specify the IP address of the ARP entry for deleting.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to delete an ARP entry whose IP Address is 192.168.40.101.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no arp 192.168.40.101
DUT-1(config)#exit
DUT-1#write memory
DUT-1#
```

To display ARP entries in the ARP table, use the following command in Enable mode.

Command	Description
show arp	Display ARP Table.

The following is an example of displaying ARP table.

```
DUT-1#show arp
--------------------------------------------------------------------------
Address               HWtype  HWaddress         Flags Mask       Iface
--------------------------------------------------------------------------
192.168.40.101         ether   00:0E:DC:31:00:12   CM              vlan1.10
192.168.40.254         ether   00:01:02:57:2A:49   C               vlan1.10
--------------------------------------------------------------------------
* Flags: C=complete, P=published, M=manual
--------------------------------------------------------------------------
```

Displaying System Uptime

You can show the time how long your system has been running after booting.

To display running time of your system, use the following command in Enable mode.

Command	Description
show uptime	Display running time of your system after booting.

The following is an example of displaying system uptime.

```
DUT-1#show uptime
8 Hour(s) 5 Minute(s) 48 Second(s) Elapsed
DUT-1#
```

Displaying Average CPU Utilization

You can show the average CPU utilization of your system. To display CPU utilization, use the following command in Enable mode.

Command	Description
show cpu-load	Display average CPU utilization.

The following is an example displaying average CPU utilization.

```
DUT-1#show cpu-load
MeasureTime     CPU-Load
--------------------------------------------------------------------------------
  5 Sec         1.60 %
  1 Min         1.06 %
 10 Min         0.89 %
DUT-1#
```

Displaying Memory Utilization

You can show the memory utilization of your system. To display memory utilization, use the following command in Enable mode.

Command	Description
show memory	Display memory utilization.

The following is an example displaying memory utilization.

```
DUT-1#show memory
Total    :  246730752 bytes
Used     :  181493760 bytes(73.56 %)
Free     :   65236992 bytes
--------------------------------------------------------------------------------
DUT-1#
```

Displaying Version of System Image

You can show the system image version, the time creating system image, and size of the system Image running in your system. To display the information of the system image, use the following command in Enable mode.

Command	Description
show version	Displaying information of system image running on your system.

The following is an example displaying the information of system image.

```
DUT-1#show version
TOS version     : 2.1.7
```

```
Hardware version : 1.2
LOT number      : 2006/04(YYYY/MM)
Image at flash1:

   Image Name:   PPC405EP-EX2124PLUS v06.06.08-2251K
   Created:     2006-06-08   13:52:09 UTC
   Data Size:    13944981 Bytes = 13.3 MB
DUT-1#
```

Displaying Information of Installed System Image

You can store two OS image on your system, and you can select a booting OS image. Before you select an OS image, you must verify the information of each OS image.

To display the information of each OS image in the flash memory, use the following command in Enable mode.

Command	Description
show os-image flash *flash-id*	Display the information of OS images in the flash memory. For *flash-id*, specify the flash memory area number. The range is 1 to 2.

The following is an example displaying the information of the OS image in the flash memory area 1.

```
DUT-1#show os-image flash 1
Image at flash1:

   Image Name:   PPC405EP-EX2124P v06.06.08-2251
   Created:     2006-06-08   13:52:09 UTC
   Data Size: 13944981 Bytes = 13.3 MB
DUT-1#
```

Displaying System Environment Status

You can show the internal temperature of the system and the status of the FAN. To display the system environment status, use the following command in Enable mode.

Command	Description
show environment temperature	Displaying the internal temperature of the system.
show environment external	Displaying the status of external FAN or the door status of the cabinet that contains VX-MD3024 system

The following is an example displaying the FAN status, internal temperature, and the external FAN and door status of the external cabinet.

```
DUT-1#show environment door
External installation's status informations
      | External door       | Opened


DUT-1#show environment temperature
*********************************************************************
                          System Temperature
*********************************************************************
temperature : 41.50 Grad Celsius
---------------------------------------------------------------------
DUT-1#


DUT-1#show environment power
      Power unit status
            | PSB Equipment                | EQUIPED
            | Communication Status          | Normal
            | Power unit type              | AC-type
            | Operating power type          | AC
            | Power change status           | Battery -> AC at 2006-09-29
04:46:37
            | AC/DC Output Voltage          | 37.10 V
```

```
      | AC/DC Output current          | 1.50 A
      | DC/DC 12V Output Voltage      | 12.19 V
      | DC/DC 3.3V Output Voltage     | 3.29 V
      | Temperature                   | 47.00 Degrees Celsius
 Battery status
      | Output Voltage                | 7.00 V
      | Over discharge                | Over discharge
      | Charge status                 | Charging Off
      | Charging Temperature Range    | -10 ~ 60 Degrees Celsius
      | Temperature                   | -50.00 Degrees Celsius

DUT-1#
```

4.4 Configuring Ping Monitoring Function

You usually use ping packets to check the live status of systems consists of your network. If you cannot communicate with your system by a problem happens in your system itself or other reason. If the reason that you cannot communicate with a system is the system problem, you must go near the system and fix the problem or reboot system. To solve this problem in VX-MD3024 system, it sends ping packets to the default router periodically and monitors the response. When the continuous fail count of ping test is over the threshold you have configured, the system reboot automatically.

This section describes the following functions:

- ✓ Configuring Ping Period
- ✓ Configuring Ping Fail Threshold to Restart System
- ✓ Configuring Lockout Period of Ping Monitoring Function
- ✓ Configuring the Maximum Reset Count to Lockout
- ✓ Enable Ping Monitoring Function
- ✓ Displaying Ping Monitoring Status

Configuring Ping Period

It is possible that a system tries to send ping packets continuously increase too much the utilization of CPU. Therefore you can set the interval between ping packets to reduce the CPU utilization.

Beginning in Enable mode, follow these steps to set the interval between ping packets.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**gateway-ping-check interval** *interval*	Set the interval between ping tests For *interval*, specify the ping test interval. The range is 10 to 86400. The default *interval* is 30 seconds.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to set the ping interval to 60 seconds.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#gateway-ping-check interval 60
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#
```

Configuring Ping Fail Threshold to Restart System

VX-MD3024 system sends three ping packets in the every ping test, and decides whether the result of ping test is failed or not. If you cannot receive any ping response packets, you decide this ping test is failed. But sometimes you can get the fail result by traffic congestion of the network. To protect a system from rebooting by traffic congestion, you can configure the continuous fail count of ping test before rebooting system. Thus the system only reboot in the case that the system continuously fails

the threshold count you have set.

Beginning in Enable mode, follow these steps to set the ping fail threshold count.

	Command	Description
Step 1	**configure terminal**	Enter global configuration command.
Step 2	**gateway-ping-check check-count** *count*	Configure the ping fail threshold count to restart system. For *count*, specify the ping fail threshold count to restart system. The range is 10 to 86400. The default value is 5
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the ping fail threshold count to 3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#gateway-ping-check check-count 3
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#
```

Configuring Lockout Period of Ping Monitoring Function

If you configure to reboot whenever the system detect continuous ping fail count is over than you configured threshold count, when the uplink port of the system is down, the system will reset endlessly repeated. To solve this problem VX-MD3024 system lockout the ping monitoring function when the reboot count by ping fail is over than the maximum reset count during the configured period.

Beginning in Enable mode, follow these steps to configure the lockout period.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**gateway-ping-check period** *period*	Configure the lockout period for locking out the ping monitoring function. The default lockout period is 86400 seconds. The range is 100 to 259200.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

The system manages the rebooting history information during lockout period you have configured. The older rebooting history than lockout period is automatically removed.

This example shows how to set the lockout period to 7200 seconds.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#gateway-ping-check period 7200
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#
```

Configuring the Maximum Reset Count to Lockout

You can configure also the maximum reset count to lockout. The system counts the reset count by ping fail to lockout ping monitoring function. If the reset count of the system is over the allowed maximum reset count, the system locks out the ping monitoring function.

Beginning in Enable mode, follow these steps to configure the maximum reset count.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.

Step 2	**gateway-ping-check max-reset** *count*	Configure the maximum reset count. The default maximum reset count is 5. The range is 1 to 15.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to set the maximum reset count during lockout period to 3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#gateway-ping-check max-reset 3
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#
```

Enable Ping Monitoring Function

The default the ping monitoring status is disabled. You can enable the ping monitoring function.

Beginning in Enable mode, follow these steps to enable the ping monitoring function.

	Command	**Description**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service gateway-ping-check**	Enable the ping monitoring function.
Step 3	**exit**	Return to Enable mode.
Step 4	**write memory**	(Optional) Save your entries in the configuration file.

To disable the ping monitoring function, use the **no service gateway-ping-check** command in global configuration mode. This example shows how to enable the ping monitoring function.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#service gateway-ping-check
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#
```

After being locked out the ping monitoring function, you should enable the ping monitoring function again manually by using CLI command to make the ping monitoring function enable.

Displaying Ping Monitoring Status

You can show the ping monitoring status of your system. To display the ping monitoring status, use the following command in Enable mode.

Command	Description
show gateway-ping-check	Display the ping monitoring status.

The following shows the example displaying the ping monitoring status.

```
DUT-1#show gateway-ping-check
+ Gateway ping check : ENABLED
    - Ping Interval(*)      : 100 seconds
    - Checking count(*)     : 3
    - Maximum Reset Count(*) : 3
    - Checking Period(*)    : 7200 seconds
    c.f.) (*) means non-default values
+ Gateway information
    - Default gateway #1 IP : 192.168.40.254
     -> the last pinging is success
+ System reset by gateway ping check information
    - System reset is unlocked
     system reset due to gateway ping fail(2005/10/27 11:12:09)
DUT-1#
```

4.5 Restart System

Upgrading OS image and other various reason cause the need for rebooting a system. This section describes the following items about rebooting system.

- ✓ Rebooting System
- ✓ Selecting Boot OS Image
- ✓ Scheduling a Rebooting System

Rebooting System

To reboot system, use the following command in Enable mode.

Command	Description
reload	Restart system

If you reboot system without saving the changed configuration, it will be lost. So you have to save the changed configuration in the configuration file before rebooting. Not to make a mistake, VX-MD3024 system is supposed to inform to you the following message to ask if you really want to reboot without saving configuration. If you want to save the configuration, press “y” key, if you want to reboot without saving the configuration, press “n” key.

The following is an example reloading system.

```
DUT-1#reload
configuration is changed..
save configuration? (y/N): y
[OK]
reboot system? (y/n): n
DUT-1#
```

Selecting Boot OS Image

VX-MD3024 system is able to have two OS Image, and you can select a booting OS Image from two stored OS images.

To display which OS image is current booting OS image and which OS image will be used at next booting time, use the following command in Enable mode.

Command	Description
show os-image	Display the current booting OS image and next time booting OS image information.

The following is the example displaying booting OS image information.

```
DUT-1#show os-image
Current Booted OS Image : FLASH Bank 1
Next-time-Boot OS Image : FLASH Bank 1
DUT-1#
```

You can find the current using OS image is stored in Flash Bank 1 and it will be used for next time also.

You can change the next time booting OS image. Before you select the next time booting OS image, you should check the information of OS images stored in each flash bank. You can select the next time booting OS image with flash bank number or the name of the OS image.

To select the next time booting OS image, use the following command in global configuration mode.

Command	Description
boot-os-image flash *flash-id*	Select the next time booting OS image with flash bank number. For *flash-id*, specify the flash bank number. The

	range is 1 to 2.
boot-os-image image-name *image-name*	Select the next time booting OS image with the name of the OS image. For *image-name*, specify the name of the OS image

This example shows how to select the next time boot OS image to the flash bank 2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#boot-os-image flash 2
DUT-1(config)#exit
DUT-1#write memory
[OK]
DUT-1#show os-image
*********************************************************************
                          OS Image Information
*********************************************************************
Current Booted OS Image : FLASH Bank 1
Next-time-Boot OS Image : FLASH Bank 2
---------------------------------------------------------------------
DUT-1#
```

This example shows how to select the next time boot OS image with the name of the OS image.

```
DUT-1#show os-image flash 1
Image at flash1:

   Image Name:   PPC405EP-EX2124P v06.06.08-2251
   Created:     2006-06-08   13:52:09 UTC
   Data Size: 13944981 Bytes = 13.3 MB

DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#boot-os-image image-name PPC405EP-EX2124P v06.06.08-2251
DUT-1(config)#exit
```

```
DUT-1#write memory
[OK]

DUT-1#show os-image
Current Booted OS Image : FLASH Bank 1
Next-time-Boot OS Image : FLASH Bank 1
DUT-1#
```

Scheduling a Rebooting System

You can schedule a rebooting system to occur on the system at a later time (for example, late at night or during the weekend when the system is used less), or you can synchronize a reboot network-wide (for example, to perform a software upgrade on all systems in the network).

To configure you system to reboot at a later time, use one of the following commands in Enable mode.

Command	Description
reload in *hours minutes*	Schedule a rebooting system to take affect in the specified minutes or hours and minutes
reload at *year month day hour minute*	Schedule a rebooting system to take affect at the specified time.

Note A scheduled reboot must take place within approximately 24 hours.

This example shows how to reboot the system in 2 hours 30 minutes

```
DUT-1#reload in 2 30
DUT-1#
```

This example shows how to reboot the system at a future time.

```
DUT-1#reload at 2006 11 25 3 30
DUT-1#
```

You can cancel the scheduled rebooting. To cancel the rebooting schedule, use the following commands in Enable mode.

Commands	Description
no reload in	Cancel the rebooting schedule.
no reload at	Cancel the rebooting schedule.

You can show the scheduled rebooting information. To display the scheduled rebooting information, use the following command in Enable mode.

Command	Description
show reload	Display the scheduled rebooting information.

This example shows how to display the scheduled rebooting information and cancel a scheduled reboot.

```
DUT-1#show reload
+ System is reloaded at 2006-11-30 11:20:00(YYYY-MM-DD HH:MM)
+ executed after 98 days 21 hours 11 minutes 57 seconds

DUT-1#no reload at
DUT-1#
```

4.6 Automatic CLI Execution

Sometimes you might want to execute some commands periodically. You can configure the automatic CLI execution function to run a sequence of commands periodically or at the specified time every day. To configure the automatic CLI execution function, supports the following functions.

- Downloading Input File and Uploading Result File

- Scheduling the Execution of Automatic CLI
- Special String To Replace the File Name
- Special Command
- Displaying the Information of Automatic CLI

Downloading an Input File and Uploading Result File

You must write an input file in which a series of commands to execute are written, to configure the automatic CLI execution function. And you should download the input file to your system using FTP or TFTP protocol from the server. Use the following Privileged EXEC commands to download the input file to your system.

Command	Description
copy autocmd-input tftp *ip-address src-file-name dest-file-name*	Download the input file from a TFTP server. For *ip-address*, specify the IP address of a TFTP server. For *src-file-name*, specify the input file name in the TFTP server. For *dest-file-name*, specify the destination file name will be stored in the system.
copy autocmd-input ftp *ip-address user-id password src-file-name dest-file-name*	Download the input file from a FTP server. For *ip-address*, specify the IP address of a FTP server. For *user-id*, specify an user-id that will be used for downloading from the FTP server. For *password*, specify the password of the user on the FTP server. For *src-file-name*, specify the input file name in the FTP server. For *dest-file-name*, specify the destination file name stored in your system.

You need the result file that includes the results created by execution the commands specified in the input file to monitor your system status or the results of executed commands. Thus you can configure your system to upload the result file to the FTP or TFTP server. Use the following Privileged EXEC commands to configure your system to upload the result file after executing the commands specified in input file.

Command	Description
copy autocmd-output *src-file-name* **tftp** *ip-address dest-file-name*	Uploads the result file to a TFTP server. For *ip-address*, specify the IP address of a TFTP server. For *src-file-name*, specify the output file name to upload to the TFTP server. For *dest -path*, specify the destination directory name to store it on the TFTP server.
copy autocmd-output *src-file-name* **ftp** *ip-address user-id password dest-path*	Uploads the result file to a FTP server. For *ip-address*, specify the IP address of a FTP server. For user-id, specify an user-id that will be used for uploading to the FTP server. For password, specify the password of the user on the FTP server. For *src-file-name*, specify the output file name to upload to the FTP server. For *dest-path*, specify the destination directory name to store it on the FTP server.

Scheduling the Execution of Automatic CLI

After downloading the input file to your system, you can configure the commands specified in the input file to be executed once a day at the specified time or once at the specified time. And you can schedule that the commands are executed every specific interval and execute the commands directly.

To configure the commands specified in the input file to be executed once a day at the specified time,

use the following Privileged EXEC commands.

Command	Description
autocmd *input-file* **every** *hour minute* [*output-file*| **no-output**] [**tftp** *ip-address*]	Configure the commands in the specified input file to be executed once a day at every specific time and upload the result file to the TFTP server. For *input-file*, specify the file name of the input file including commands list to execute at every specified time. For *hour*, specify the hour to execute the commands listed in the input-file. The range is 0 to 23. For minute, specify the minute to execute the commands. The range is 0 to 59. For *output-file*, specify the output file name including the results displayed by the executed commands. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the automatically generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. You can send the output file to the specified TFTP server after finishing the execution of the command list in the input file automatically. The output file will be removed automatically after sending it successfully. If you don't specify the tftp server, the output file would not be uploaded to the server and the output file will be stored in your system. You can upload the output file the other time when you want to send it to a server. And the output file will be kept until your system is reloaded. For **no-output**, specify this keyword instead of the output file name to make no output file. For *ip-address*, specify the IP address of a TFTP server.
autocmd *input-file* **every** *hour minute* [*output-file*| **no-output**] [**ftp** *ip-address user-id*	Configure the commands specified in the input file to be executed once a day at every specific time

password path]	and upload the result file to the FTP server. For *input-file*, specify the file name of the input file including command list to execute at the specified time every day. For *hour* and *minute*, specify the time to execute the command listed in the input-file. For *output-file*, specify the output file name including the results displayed by executed command. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. You can send the output file to the specified FTP server after finishing the execution of the command list in the input file automatically. For **no-output**, specify this keyword instead of the output file name to make no output file. For *ip-address*, specify the IP address of a FTP server. For user-id, specify an user-id that will be used for downloading in the FTP server. For password, specify the password of the user in the FTP server. For *path,* specify the directory name in which the output file is stored.

To configure the commands specified in the input file to be executed once at the specified time, use the following Privileged EXEC commands.

Command	Description
autocmd *input-file* **at** *year month day hour minute* [*output-file*| **no-output**] [**tftp** *ip-address*]	Configure the commands specified in the input file to be executed once at the specific time and upload the result file to the TFTP server. For *input-file*, specify the file name of the input file including commands list to execute at the specified

	time. For *year*, specify the year to execute the commands listed in the input file. The range is 2000 to 2035. For *month*, specify the month to execute the commands. The range is 1 to 12. For *day*, specify the day to execute the commands. The range is 1 to 31. For *hour*, specify the hour to execute the commands. The range is 0 to 23. For minute, specify the minute to execute the commands. The range is 0 to 59. For *output-file*, specify the output file name including the results displayed by executed commands. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. You can send the output file to the specified TFTP server after finishing the execution of the command list in the input file automatically. The output file will be removed automatically after sending it successfully. If you don't specify the tftp server, the output file would not be uploaded to the server and the output file will be stored in your system. You can upload the output file the other time when you want to send it to a server. And the output file will be kept until your system is reloaded. For **no-output**, specify this keyword instead of the output file name to make no output file. For *ip-address*, specify the IP address of a TFTP server.
autocmd *input-file file* **at** *year month day hour minute* [*output-file*| **no-output**] [**ftp** *ip-address user-id password path*]	Configure the commands specified in the input file to be executed once at the specific time and upload the result file to the FTP server. If you don't specify the FTP server, the result file would not transfer to the FTP server.

	For *input-file*, specify the file name of the input file including command list to execute at the specified time every day. For *year*, specify the year to execute the commands listed in the input file. The range is 2000 to 2035. For *month*, specify the month to execute the commands. The range is 1 to 12. For *day*, specify the day to execute the commands. The range is 1 to 31. For *hour* and *minute*, specify the time to execute the command listed in the input-file. For *output-file*, specify the output file name including the results displayed by executed command. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. You can send the output file to the specified FTP server after finishing the execution of the command list in the input file automatically. For **no-output**, specify this keyword instead of the output file name to make no output file. For *ip-address*, specify the IP address of a FTP server. For user-id, specify an user-id that will be used for downloading in the FTP server. For password, specify the password of the user in the FTP server. For *path,* specify the directory name in which the output file is stored.

To configure the commands specified in the input file to be executed every interval periodically, use the following Privileged EXEC commands.

Command	Description
autocmd *input-file* **interval** *hour minute* [*output-file*| **no-output**] [**tftp** *ip-address*]	Configure the commands specified in the input file to be executed every interval periodically and upload the result file to the TFTP server after execution. If you don't specify the TFTP server, the result file would not transfer to the TFTP server. For *input-file*, specify the file name of the input file including commands list to execute every interval time. For *hour*, specify the hour of the interval to execute the commands. The range is 0 to 23. For minute, specify the minute of the interval to execute the commands. The range is 0 to 59. For *output-file*, specify the output file name including the results displayed by executed commands. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. You can send the output file to the specified TFTP server after finishing the execution of the command list in the input file automatically. The output file will be removed automatically after sending it successfully. If you don't specify the tftp server, the output file would not be uploaded to the server and the output file will be stored in your system. You can upload the output file the other time when you want to send it to a server. And the output file will be kept until your system is reloaded. For **no-output**, specify this keyword instead of the output file name to make no output file. For *ip-address*, specify the IP address of a TFTP server.
autocmd *input-file* **interval** *hour minute* [*output-file*| **no-output**] [**ftp** *ip-address user-id password path*]	Configure the commands specified in the input file to be executed every interval periodically and upload the result file to the FTP server after execution. If you don't specify the FTP server, the

	result file would not transfer to the FTP server. For *input-file*, specify the file name of the input file including command list to execute every interval time. For *hour* and *minute*, specify the interval to execute the commands listed in the input-file. For *output-file*, specify the output file name including the results displayed by executed command. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. You can send the output file to the specified FTP server after finishing the execution of the command list in the input file automatically. For **no-output**, specify this keyword instead of the output file name to make no output file. For *ip-address*, specify the IP address of a FTP server. For user-id, specify an user-id that will be used for downloading in the FTP server. For password, specify the password of the user in the FTP server. For *path,* specify the directory name in which the output file is stored.

You can also configure the commands specified in the input file to be executed directly. To configure the commands specified in the input file to be executed immediately, use the following Privileged EXEC commands.

Command	Description
autocmd *input-file* [*output-file* | **terminal | no-output**]	Execute the commands specified in the input file immediately. For *input-file*, specify the file name of the input file including commands list to execute.

	For *output-file*, specify the name of the output file including the results displayed by executed command. If the output-file is not specified, the system automatically generate an output-file of which the name is IP address + input file name + the execution time. The IP address of the generated output file name is the IP address of the vlan of which vlan ID is lowest on the system. For **no-output**, specify this keyword instead of the output file name to make no output file. For **terminal**, specify this keyword to display the result of executed commands to the console.

Special String To Replace the File Name

When you make the input file with the commands to execute automatically, sometimes you need the special method make a command that use each other file name with a same string. For example, when you write the input file to upload the configuration file of your system to a FTP server to backup the configuration file periodically, you might want to store the configuration file of each system to each other file name using a same command with special string.

This special string can be used only in the input file to execute automatic CLI. If you use the special string in normal terminal mode, the command will be fail.

You can use the following string to replace the special string to the IP address of your system.

Special String	Description
$ipaddr$	Replaces this string to the IP address of VLAN1.1 (The default VLAN).
$ipaddr:vlan-name$	Replaces this string to the IP address of the specified VLAN. For **vlan-name**, specify the VLAN of which IP address would be replaced

These examples show how to replace the special string to the file names applying replacement rule in the system which the IP address of VLAN1.1 is 192.168.0.100 and the IP address of VLAN1.10 is 192.168.10.11 in.

Used File Name	Applied File Name
Config_$ipaddr$_Test	Config_192.168.0.100_Test
Config_$ipaddr:vlan1.10$_Test	Config_192.168.10.11_Test

If the specified VLAN is not assigned IP address, the command including a special string would be failed automatically.

Special Commands

Sometimes when you make your input file to be used to execute automatic CLI, you need a special command to wait for the duration without any action before executes the next command. You can use the following Privileged EXEC command to specify the delay time in the input file.

Command	Description
sleep *delay*	Wait for the specified duration without any action. For *delay*, specify the time delay to wait to execute the next command. The unit of the delay is seconds. And the range is 0 to 86400. This command can be used on all command modes.

When you make the input file, you should not use the interactive command that requests the additional input from the operator in the input file. But VX-MD3024 always requests the confirmation from you when you try to reload your system.

When you make the input file including the command to reload your system, you should not use the reload command. Thus you need the other reload command to use that command in the input file. The following is the new command to reload your system without your confirmation and this command can

be used in the input file to reload your system.

Command	Description
reload force	Reload a system by force without your confirmation.

Displaying the Information of Automatic CLI Execution

You can display the information related with the automatic CLI execution to manage the automatic CLI. And you can show the information of downloaded input files to be used for automatic CLI execution and the result files created by automatic CLI execution.

To display the scheduled automatic CLI execution, use the following Privileged EXEC command.

Command	Description
show autocmd	Display the information of scheduled automatic CLI executions on your system
show autocmd detail	Display the detailed information of scheduled automatic CLI executions on your system.

This example shows how to display the information of automatic CLI. You can find the input file name, the scheduling type, scheduled execution time and the output file name. The scheduling type describes whether the automatic CLI executes once a day at every specified time or once. And you can see whether the output file is already sent to the FTP or TFTP server.

```
DUT-1#show autocmd
Input filename      Type      Execution time      Output filename
-------------------------------------------------------------------------------
autoIn            Intervally ----/--/-- 00:10:00  test_out(*)

c.f.) (*) means output file transferring to remote.
     To show detail information use 'show autocmd detail' command
-------------------------------------------------------------------------------
+ IP address for default output filename : 192.168.31.120
```

```
+ Autocmd ouptut file total size limits  : 1024 KB
DUT-1#
```

This example shows how to display the detailed information of automatic CLI scheduled. You can show the information of a FTP or TFTP server in which the result file would be stored.

```
DUT-1#show autocmd detail
Input filename : autoIn
Execution type : Intervally
Execution time : ----/--/-- 00:10:00
Output filename : test_out(*)
Output file transfer : TFTP
   server IP = 192.168.40.116

c.f.> (*) means the output file would be removed after transferring
DUT-1#
```

To display the downloaded input files and the result files, use the following Privileged EXEC commands.

Command	Description
show autocmd input-file	Display the downloaded input files
show autocmd input-file *file-name*	Display the contents of the specified input file that is downloaded to execute automatic CLI.
show autocmd output-file	Display the result files those are generated by executing the automatic CLI.
show autocmd output-file *file-name*	Display the contents of the specified result file that is generated by executing automatic CLI.

4.7 System Security

For system security, VX-MD3024 supports the following protection functions

- ✓ ICMP Control Function
- ✓ TCP Control Function

ICMP Control Function

(1) Ignoring ICMP Echo Requests

You can configure your system chooses to totally ignore all ICMP Echo requests. If you configure the ICMP Echo reply function to deny, you and others will be unable to ping your system.

Beginning in Privileged EXEC mode, follow these steps to configure your system to deny all ICMP Echo request.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip icmp echo all** *[deny|allow]*	Configure whether your system reply to the all received ICMP Echo requests or not. By default, your system will send the ICMP Echo reply messages, if you don't configure anything. If you configure this function to deny mode, your system will not reply to the ICMP Echo requests.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show ip icmp**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

(2) Ignoring Broadcast ICMP Echo Requests

This configuration works precisely the same as ignoring ICMP Echo requests except that it will only ignore those ICMP messages sent to broadcast or multicast addresses. It should be quite obvious why this is good, it would among other things stop this specific host from being part of smurf attacks and likely problems. Broadcast pings are generally bad unless you are using this to find out how many

hosts on your network(s) are up or not. This function is default turn off.

Beginning in Privileged EXEC mode, follow these steps to enable this function.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip icmp echo broadcast** *[deny|allow]*	Configure your system to ignore those ICMP messages sent to broadcast or multicast addresses. By default, this function turns off.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show ip icmp**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

(3) Configuring ICMP Rate Limit

The ICMP rate limit is the maximum rate at which your system generates ICMP messages of the types specified by the **ip icmp ratelimit field** global configuration command. The configured value is the interval that your system has to wait between sending two such messages. Therefore zero means no limit. And The unit of this value is ms (millisecond) and if you set the ICMP rate limit to 1000ms, it sends 1 ICMP packet per second.

Beginning in Privileged EXEC mode, follow these steps to configure the ICMP rate limit.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip icmp ratelimit interval** *interval*	Configure the interval that your system has to wait between sending two ICMP messages. The default value is 1000ms and the range is 1 to 2147483647.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show ip icmp**	Verify your entries.

Step 5	**write memory**	(Optional) Save your entries in the configuration file.

(4) Configuring ICMP Type to apply ICMP Rate Limit.

You can configure the ICMP types should be rate limited with the value that is configured by the **ip icmp ratelimit interval** global configuration command. For all ICMP types you selected the rate limit is applied. Thus the other ICMP packets which is not selected by you are allowed though the sending rate is exceed. You can select one or more ICMP types to apply the sending rate limit.

An attacker could cause a correctly operating host or router to flood a victim with ICMP replies by sending it packets that generate replies back to the source address of the victim. It is important in some cases to send such replies, but hardly ever important to generate them at a very high rate.

Beginning in Privileged EXEC mode, follow these steps to configure the ICMP types to apply the ICMP rate limit.

	Command	**Description**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip icmp ratelimit field** *{add-mask-req* | *add-mask-resp* | *dest-unreach* | *echo-req* | *echo-resp* | *info-req* | *info-resp* | *param-problem* | *redirect* | *source-quench* | *time-exceed* | *timestamp-req*|*timestamp-resp}*	Configure the ICMP types to apply the ICMP rate limit.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show ip icmp**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

(5) Configuring the Destination Unreachable ICMP Filter

You can configure the destination unreachable ICMP filtering function of each Layer 3 interface. When

you disable sending function of the destination unreachable ICMP packets, the system can not send the destination unreachable ICMP packets through the Layer 3 interface. And when you disable receiving function of the destination unreachable ICMP packets, those packets received from the specified Layer 3 interface are automatically discarded. The default configuration is enable sending and receiving the destination unreachable ICMP packets of all Layer 3 interfaces.

Beginning in Privileged EXEC mode, follow these steps to configure whether you allow a Layer 3 interface to send or receive the destination unreachable ICMP packets.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode.
Step 3	**ip icmp dest-unreachable {rx | tx} {deny | allow}**	Configure sending or receiving function of the destination unreachable ICMP packets For **{tx|rx}**, select the direction to apply filtering function. For **deny**, specify to discard the destination unreachable ICMP packets. For **allow**, specify to allow the destination unreachable ICMP packets.
Step 4	**end**	Return to Privileged EXEC mode.
Step 5	**show ip icmp**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file

(6) Configuring the Redirect ICMP Filtering

You can configure whether you accept the redirect ICMP packets from a Layer 3 interface or not. And also you can configure whether the system sends the redirect ICMP packets to a Layer 3 interface or not. The default configuration is enable sending and receiving the redirect ICMP packets of all Layer 3 interfaces.

Beginning in Privileged EXEC mode, follow these steps to configure whether you allow a Layer 3 interface to send or receive the redirect ICMP packets.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and specify the Layer 3 interface name.
Step 3	**ip icmp redirect {rx | tx} {deny | allow}**	Configure sending or receiving function of the redirect ICMP packets. For **{tx|rx}**, select the direction to apply filtering function. For **deny**, specify to discard the redirect ICMP packets. For **allow**, specify to allow the redirect ICMP packets.
Step 4	**end**	Return to Privileged EXEC mode.
Step 5	**show ip icmp**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file

(7) Displaying ICMP control Status

You can display the ICMP control status configured on your system. Use the following command to display the ICMP control status.

Command	Description
show ip icmp	Display the ICMP control status of your system.

This example shows how to display ICMP control status.

```
DUT-1#show ip icmp
+ Ignore ICMP Echo All      : Disabled
+ Ignore ICMP Echo Broadcast :  Enabled

+ ICMP Ratelimit Interval: 1000 msec
+ ICMP Ratelimit Fields  :
      dest-unreach
      source-quench
      time-exceeded
```

```
      param-problem
      addr-mask-req

+ Allow ICMP Redirect
Interface        Rx         Tx
lo               Enabled    Enabled
eth0             Enabled    Enabled
vlan1.10         Disabled   Enabled
vlan1.101        Enabled    Enabled

+ Allow ICMP Destination-unreachable
Interface        Rx         Tx
lo               Enabled    Enabled
eth0             Enabled    Enabled
vlan1.10         Enabled    Enabled
vlan1.101        Enabled    Enabled
```

TCP Control Function

The TCP (Transmission Control Protocol) Header includes URG, ACK, PSH, RST, SYN, and FIN flags. You can control RST and SYN Flag of TCP packets for system security.

(1) Configure RST Flag

The RST flag informs the peer systems those try to connect with your system about the fact the requested port is not open. But hackers use the function to search the IP address of operating system in the network. You can configure the function sending RST flag packets to prevent your system from sending reply packets set RST flags to the hacker system. By default, your system allows sending TCP packets set RST flag.

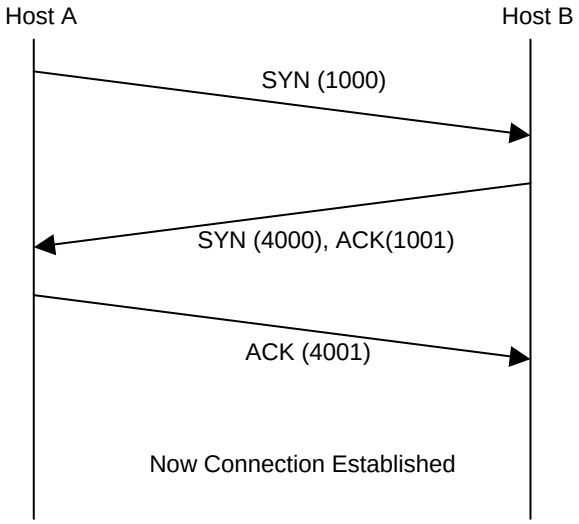
Beginning in Privileged EXEC mode, follow these steps to configure the RST Flag sending function.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip tcp rst tx {permit | discard}**	Configure whether you allow sending RST packets.

		For **permit**, specify to send RST packets. For **discard**, specify to block RST packets. The default value is permit.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show ip tcp**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file

(2) SYN Attack Protection

The TCP protocol use reliable connection unlike UDP. Thus the TCP protocol needs “3 Way Handshaking” procedure to start communication between a server and a client.



[3 Way Handshaking]

A client sends SYN packet requesting connection to the server. The server received SYN packet sends SYN packet and ACK packet to allow the connection request. After the client receive those packets, it send ACK packet to the server and the connection is established finally. After the connection is established with 3 Way Handshaking procedures, the data can be exchanged.

The above procedure is basic flow of TCP connection. But A hacker (Host A) sends SYN packet and receives response (SYN + ACK) from the server (Host B), it does not send the ACK packet. Then the

server sent SYN and ACK packets waits the response from the client (Host A) and keeps the connection with “Half Open“ Status. The server initialize the connection in a period (75 seconds). But the connection is kept in the Incomplete Connection Queue during the period.

Generally, a Hacker sends SYN packet with randomly selected source IP address continuously and the server received these packets add a connection created by the SYN packet to the Incomplete Connection Queue and sends the response packet. But the hacker does not send any reply packets. The size of the server’s Incomplete Connection Queue increase continuously, finally the server cannot support more TCP connection. The server cannot reply to the normal connection requests in this status and cannot service.

EX-2108BD contains the mechanism to protect it from SYN flooding attack. The system sends SYN and Cookies instead of a sequence number when the protection mechanism enables. Then it only allow the connection after it receives the sent Cookies.

Beginning in Privileged EXEC mode, follow these steps to configure the SYN Cookies function.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip tcp syncookie**	Enable SYN Cookies function. The default configuration is disable.
Step 3	**end**	Return to Privileged EXEC mode.
Step 4	**show ip tcp**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file

To disable the SYN Cookies function, use the **no ip tcp syncookie** command in global configuration mode.

Chapter 5 Configuring VDSL

This chapter describes how to configure VDSL on your system and how to inquire to it's configure and status.

This chapter consists of these sections:

- Configuring VDSL Interface
- Displaying Information of VDSL Interface
- Configuring VDSL Configuration Profile
- Configuring VDSL Alarm Profile
- Upgrading VDSL Modem Image
- Configuring VDSL System Environments

5.1 Configuring VDSL Interface

These sections describe how to configure VDSL Interface:

- ✓ Default VDSL Interface Configuration
- ✓ Configuring Status of VDSL Interface
- ✓ Applying VDSL Configuration Profile to a VDSL Interface
- ✓ Applying VDSL Alarm Profile to a VDSL Interface
- ✓ Initializing VDSL Interface

Default VDSL Interface Configuration

The following table shows the default VDSL interface configuration.

Feature	Default Setting
Interface status	**Enabled**
VDSL configuring profile	**default**
VDSL alarming profile	**default**

Configuring Status of VDSL Interface

If you do not use VDSL Interface, configure administrative status of VDSL Interface to disable. If you set the administrative state of a VDSL interface to disable, the VDSL interface does not try to make a connection with a modem. If the link status of the interface is already connected, the link would be

broken after setting the status to disable.

To reuse the disabled VDSL Interface, you can change the administrative status of the interface to enable status.

Beginning in Enable mode, follow these steps to configure the administrative status of a VDSL interface.

	Commands	Descriptions
Step 1	**configure terminal**	Enter to Global Configuring Mode
Step 2	**vdsl interface** *ifname*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**shutdown / no shutdown**	Configure the administrative status of VDSL Interface
Step 4	**end**	Return to Enable Mode.
Step 5	**show running-config vdsl interface** *[ifname]* **show vdsl interface** *[ifname]* **brief** **show vdsl interface** *[ifname]* **show vdsl interface** *[ifname]* **detail**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to set the administrative status of the VDSL interface 1.1 to disable.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl interface 1.1
DUT-1(config-vdsl-if)#shutdown
DUT-1(config-vdsl-if)#end
DUT-1#show running-config vdsl interface 1.1
!
vdsl interface 1.1
```

```
 service-conf-profile default
 service-alarm-profile default
 shutdown
!
DUT-1#write memory
```

Applying VDSL Configuration Profile to a VDSL Interface

On VDSL system, configure first the VDSL configuration profiles those have various configuration values of each VDSL line parameter. And you can apply the pre-configured VDSL configuration profile to each VDSL interface. The VDSL configuration profile has configuring information on the transmit rate of upstream and downstream, target SNR margin, minimum SNR margin, and band-plan and so on. For detailed description of configuring the VDSL configuration profile, refer to Chapter 5.3, “Configuring VDSL configuration profile.”

When you apply a VDSL configuration profile to a VDSL Interface, the configuration parameters of the VDSL interface depend on the value defined in the VDSL configuration profile. Namely, the VDSL interface use the transmitting rate upstream and downstream, target SNR margin, and bandplan value defined in the applied VDSL configuration profile to link with CPE. If you apply a new VDSL configuration profile to the VDSL interface that is already linked on, it will restart link connection procedure with the new configuration values those are defined in the newly assigned VDSL configuration profile.

Beginning in Enable mode, follow these steps to apply VDSL configuration profile to a VDSL interface.

	Commands	**Descriptions**
Step 1	**configure terminal**	Enter to Global Configuring Mode
Step 2	**vdsl interface** *ifname*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**service-conf-profile** *profile-name*	Apply the VDSL configuration profile to a particular VDSL interface

Step 4	**end**	Return to Enable Mode.
Step 5	**show running-config vdsl interface [*ifname*]** **show vdsl interface [*ifname*] detail**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to set VDSL configuring Profile to VDSL Interface 1.1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl interface 1.1
DUT-1(config-vdsl-if)#service-conf-profile example
DUT-1(config-vdsl-if)#end
DUT-1#show running-config vdsl interface 1.1
!
vdsl interface 1.1
 service-conf-profile example
 service-alarm-profile default
!
DUT-1#write memory
```

Applying VDSL Alarm Profile to a VDSL Interface

On VDSL system, configure first the VDSL alarm profiles those have various parameters for alarm threshold values. And you can apply the pre-configured VDSL alarm profile to each VDSL interface like as the VDSL configuration profile. The VDSL alarm profile has configured threshold value of the Errored Second (ES), Severely Errored Second (SES), and UnAvailable Second (UAS) count. For detailed description of configuring the VDSL alarm profile, refer to Chapter 5.4, “Configuring VDSL alarm profile.”

After you apply a specific VDSL alarm profile to a VDSL interface, when the alarm count is over the configured threshold value, the system generates alarm event.

Beginning in Enable mode, follow these steps to apply a VDSL alarm profile to a VDSL interface.

	Commands	Descriptions
Step 1	**configure terminal**	Enter to Global Configuring Mode
Step 2	**vdsl interface** *ifname*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**service-alarm-profile** *profile-name*	Applying VDSL alarm profile to VDSL interface
Step 4	**end**	Return to Enable mode.
Step 5	**show running-config vdsl interface [***ifname***]** **show vdsl interface [***ifname***] detail**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to set VDSL alarm profile to VDSL interface 1.1..

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl interface 1.1
DUT-1(config-vdsl-if)#service-alarm-profile example
DUT-1(config-vdsl-if)#end
DUT-1#
```

Initializing VDSL Interface

Applying VDSL configuring profile to VDSL Interface, the VDSL interface tries to link on according to the specified configuration profile. You can initialize the link status to link on again with the specified configuration profile when the link status is not stable or the SNR margin value of the interface is not enough.

Beginning in Enable mode, follow these steps to initialize a VDSL Interface:

	Command	Description
Step 1	**configure terminal**	Enter to Global Configuring Mode
Step 2	**vdsl interface** *ifname*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**init**	Initialize the particular VDSL Interface
Step 4	**end**	Return to Enable mode.
Step 5	**show vdsl interface [***ifname***] brief**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to initialize VDSL Interface 1.1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl interface 1.1
DUT-1(config-vdsl-if)#init
DUT-1(config-vdsl-if)#end
DUT-1#show vdsl interface 1.1 brief
PORT   PROTECTION   ADMIN        LINK   DS PAYLOAD RATE   US PAYLOAD RATE
 1.1    -          ENABLED    TRAINING          0 kbps          0 kbps
```

In this example, the link status of the VDSL Interface 1.1 is training status as above. In a second the link status will be finished after training process.

5.2 Displaying Information of VDSL Interface

This chapter describes how to display the information of VDSL interface.

- ✓ Displaying VDSL Line Information
- ✓ Displaying Counter Information of VDSL Interface.
- ✓ Displaying Modem Information of VDSL Interface.

Displaying VDSL Line Information

To display the VDSL line information, use the following commands in Enable mode.

Commands	Descriptions
show vdsl interface [*ifname***] brief**	Display brief information of VDSL Interface
show vdsl interface [*ifname***]**	Display basic information of VDSL Interface
show vdsl interface [*ifname***] detail**	Display detailed information of VDSL Interface
show vdsl interface [*ifname***] phy**	Display physical layer information of VDSL interface.
show vdsl interface [*ifname***] {rx-bitloading | tx-bitloading}** ***start-tone-index stop-tone-index***	Display Bit-Loading information on RX / TX

The following is an example of displaying brief information of VDSL Interface 1.1.

```
DUT-1#show vdsl interface brief
PORT   PROTECTION   ADMIN         LINK   DS PAYLOAD RATE   US PAYLOAD RATE
 1.1   -           ENABLED       DOWN          0 kbps          0 kbps
 1.2   -           ENABLED         UP       99968 kbps       40256 kbps
 1.3   -           ENABLED         UP       99968 kbps       40256 kbps
 1.4   -           ENABLED         UP       99968 kbps       40256 kbps
```

```
 1.5   -          ENABLED       DOWN          0 kbps          0 kbps
 1.6   -          ENABLED         UP       99968 kbps       40256 kbps
 1.7   -          ENABLED         UP       99968 kbps       40256 kbps
 1.8   -          ENABLED         UP       99968 kbps       40256 kbps
 2.1   -          ENABLED       DOWN          0 kbps          0 kbps
 2.2   -          ENABLED       DOWN          0 kbps          0 kbps
(output truncated)
DUT-1#
```

The following is an example displaying basic information of VDSL Interface 1.1.

```
DUT-1#show vdsl interface 1.1
DUT-1#show vdsl interface 1.1
Interface 1.1
  Admin Status     : Enabled
  Link Status      : UP
  Protection Status : not protected
  DS / US line rate               :  113408 kbps /  113408 kbps
  DS / US Slow payload rate        :   99968 kbps /   99968 kbps
  DS / US attainable payload rate   :  103680 kbps /  103040 kbps
  DS / US attainable line rate      :  123136 kbps /  116864 kbps
  DS / US Training Margin          :    7.5 dB   /    7.8 dB
  DS / US delay                   :    1.8 ms   /    1.8 ms

  VDSL Estimated Loop Length       :   19.8 m
  NE / FE G.Hs Estimated Loop Length :   37.8 m   /   97.9 m
  NE / FE Tx total power           :    8.4 dBm  /    6.0 dBm

DUT-1#
```

The following is an example displaying detailed Information of VDSL Interface 1.1.

```
DUT-1#show vdsl interface 1.1 detail
Interface 1.1
  Admin Status     : Enabled
  Link Status      : UP
```

```
  Protection Status : not protected
  Link Up Time     : 0 days 00:02:05
  Retraining Reason : init
  Line Profile     : example
  Alarm Profile    : example
  Port trap       : Disabled
  Line Coding      : MCM
  Line Type       : Interleaved Only
  Framing mode     : HDLC mode

  DS / US line rate              :  113408 kbps /  113408 kbps
  DS / US Slow payload rate       :   99968 kbps /   99968 kbps
  DS / US attainable payload rate   :  103680 kbps /  103040 kbps
  DS / US attainable line rate     :  123136 kbps /  116864 kbps
  DS / US Training Margin         :    7.5 dB   /    7.8 dB
  DS / US Line Protect. (Slow Path)  :    0.0 Sym. /    0.0 Sym.
  DS / US delay                  :    1.8 ms   /    1.8 ms

  VDSL Estimated Loop Length       :   19.8 m
  NE / FE G.Hs Estimated Loop Length :   37.8 m   /   97.9 m
  NE / FE Tx total power          :    8.4 dBm  /    6.0 dBm
  NE / FE Version Number          :    1.0.5r4  /   7.2.4r12
  NE / FE ITU Vendor Id :       0xb500494b4e530000 / 0xb500494b4e530000
DUT-1#
```

The following is an example displaying PHY Information of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 phy
Interface 1.1
  Minimum SNR margin          :    5.9 dB
  Signal Attenuation          :    2.2 dB
  Attainable Upstream Line Rate :  111808 kbps
  Attainable Upstream Data Rate :  106240 kbps

  NE / FE Average SNR margin    :    8.6 dB /    7.9 dB
  NE / FE Line Attenuation     :    2.5 dB /    1.6 dB

DUT-1#
```

The following is an example displaying transmitting Bit-Loading information of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 tx-bitloading 1000 3500
TX BITLOADING
  Frequency : Bits
     991875 : 11
    1000500 : 11
    1009125 : 11
    1017750 : 11
    1026375 : 11
    1035000 : 11
   (output truncated)
    3450000 : 13
    3458625 : 13
    3467250 : 13
    3475875 : 13
    3484500 : 13
    3493125 : 13
```

Note The display command of Bit-Loading Information need a lot of data exchanges between devices, which cause in time delay to get. Sometimes, it happens timeout if the time delay is over 30 seconds. If you set the administrative status of unused VDSL interface to disable, you can get the Bit-Loading information more fast.

Displaying Counter Information of VDSL Interface

To display the counter information of VDSL Interface, follow these commands in Enable mode.

Commans	Description
show vdsl interface [*ifname***] counters**	Display the Ethernet counter information.

show vdsl interface [*ifname***] pm-counters**	Display the PM counter Information.
show vdsl interface [*ifname***] 15min-pm-log**	Display the 15 minutes PM log information.
show vdsl interface [*ifname***] 24hrs-pm-log**	Display the 1 day PM log information.

The following is an example displaying the Ethernet counter of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 counters
Interface 1.1
 Rx Frames..........:       367   Rx Bytes............:     64828
 Rx Dropped Frames...:         0   Rx Alignment Errors.:         0
 Rx Oversize........:         0   Rx Undersize........:         0
 Rx CRC Errors......:         0   Rx Carrier Sense Err:         0
 Tx Frames..........:         0   Tx Bytes............:         0
 Tx Pause Frames.....:        0
DUT-1#
```

The following is an example displaying PM counters of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 pm-counters
Interface 1.1
  Current 15 minutes PM Information
    Elapsed Time  : 00:12:28
    Init Count: 1
    Init Failure Count: 0
    NeLOS :     0, NeSEF :     0, NeLOM :     0
    FeLOS :     0, FeRDI :     0, FeLOM :     0, FeLPR :     0
    NeES  :     1, NeSES :     0, NeLOSS:     0
    FeES  :     0, FeSES :     0, FeLOSS:     0
    NeFEC :     44889, NeCRC :         1
    FeFEC :         0, FeCRC :         0
  Current 1 day PM Information
    Elapsed Time  : 10:57:29
    Init Count: 2
    Init Failure Count: 0
    NeLOS :     0, NeSEF :     0, NeLOM :     0
```

```
    FeLOS :     0, FeRDI :     0, FeLOM :     0, FeLPR :     0
    NeES  :     2, NeSES :     0, NeLOSS:     0
    FeES  :     1, FeSES :     0, FeLOSS:     0
    NeFEC :   5742588, NeCRC :         3
    FeFEC :        52, FeCRC :         1
  Total PM Information
    Elapsed Time  : 17:25:09
    Init Count: 3
    Init Failure Count: 0
    NeLOS :     0, NeSEF :     0, NeLOM :     0
    FeLOS :     0, FeRDI :     0, FeLOM :     0, FeLPR :     0
    NeES  :     2, NeSES :     0, NeLOSS:     0
    FeES  :     1, FeSES :     0, FeLOSS:     0
    NeFEC :   5742588, NeCRC :         3
    FeFEC :        61, FeCRC :         1
DUT-1#
```

The following is an example displaying 15 minutes PM log of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 15min-pm-log
================================================================================
15 minutes PM History Information
================================================================================
Interface 1.1
  END / ELAPSED TIME   SIDE      ES   SES  LOSS INITS      FECS      CRCS
  2006/08/24 10:45:00   Ne       0    0    0    0    1941444         0
             00:15:00   Fe       0    0    0    0           0         0
  2006/08/24 10:30:00   Ne       1    0    0    0    3043729         2
             00:14:59   Fe       0    0    0    0           0         0
  2006/08/24 10:15:00   Ne       0    0    0    0     708384         0
             00:15:00   Fe       0    0    0    0           0         0
  2006/08/24 10:00:00   Ne       0    0    0    0       4072         0
             00:15:01   Fe       0    0    0    0           0         0
  2006/08/24 09:45:00   Ne       0    0    0    1         70         0
             00:15:00   Fe       0    0    0    0           0         0
(output truncated)
```

The following is an example displaying 24 hours PM log of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 24hrs-pm-log
================================================================================
  24 hours PM History Information
================================================================================
Interface 1.1
  END / ELAPSED TIME   SIDE      ES   SES  LOSS INITS      FECS      CRCS
  2006/08/23 00:00:00    Ne       0    0    0    0         0         0
             06:27:40    Fe       0    0    0    0        29         0
  2006/08/24 00:00:00    Ne       0    0    0    1         0         0
             24:00:00    Fe       0    0    0    1         9         0
================================================================================
```

To initialize the counter information of VDSL interface, use the following command in Enable mode.

Commands	Descriptions
clear vdsl interface [*ifname*] **counters**	Initialize the Ethernet counter of VDSL Interface.
clear vdsl interface [*ifname*] **pm-counters**	Initialize the PM counter of VDSL interface.
clear vdsl interface [*ifname*] **15min-pm-log**	Initialize the 15 minutes PM log of VDSL interface.
clear vdsl interface [*ifname*] **24hrs-pm-log**	Initialize the 24 hours PM log of VDSL interface.

This example shows how to initialize the Ethernet counter of VDSL Interface 1.1.

```
DUT-1#clear vdsl interface 1.1 counters
DUT-1#
```

This example shows how to initialize PM counter of VDSL Interface 1.1.

```
DUT-1#clear vdsl interface 1.1 pm-counters
```

```
DUT-1#
```

This example shows how to initialize 15 minutes PM log of VDSL Interface 1.1.

```
DUT-1#clear vdsl interface 1.1 15min-pm-log
DUT-1#
```

This example shows how to initialize 24 hours PM log of VDSL Interface 1.1.

```
DUT-1#clear vdsl interface 1.1 24hrs-pm-log
DUT-1#
```

Displaying Modem Information of VDSL Interface

To display the modem information of VDSL interface, use the following command in Enable mode.

Commands	Descriptions
show vdsl interface [*ifname*] **modem-status**	Display the link status between modem and PC. The information contains link status, duplex mode, pause control status and the number of pause frame received from PC.
show vdsl interface [*ifname*] **modem-counters**	Display the counter information of modem.
show vdsl interface [*ifname*] **modem-version**	Display the modem version information.
show vdsl interface [*ifname*] **modem-image**	Display the information for the modem image.
show vdsl interface [*ifname*] **modem-upgrade-status**	Display the modem upgrade status.

The following is an example displaying the link status between modem and PC of VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 modem-status
Interface 1.1
  Modem-PC Status:
  - Link Status: UP
  - Full-duplex, 100 Mbps
  - Pause control: disabled
  - Pause Frame: 64
DUT-1#
```

The following is an example displaying the modem counters of the interface VDSL 1.1.

```
DUT-1#show vdsl interface 1.1 modem-counters
Interface 1.1
 FEC: 2133, CRC: 345, FLOS: 0, SEF: 137, FEC UnCrr: 8970
 TX: 1243760, RX:0, TX CRC: 0, RX CRC: 1, DROP: 0
DUT-1#
```

The modem is able to contain two modem firmware images. Sometimes, you would like to know the information of modem firmware images stored in the mode. A modem image's status is active means the image would be used at the next time booting.

The following is an example displaying the modem image information of the VDSL interface 1.1.

```
DUT-1#show vdsl interface 1.1 modem-image
Interface 1.1
 ID    STATUS    VERSION
  1              7.2.4r8
  2     R,A      7.2.4r12

*. R: running image, A: activated image
DUT-1#
```

The following is an example displaying the modem upgrade status of the VDSL interface 1.1.

```
DUT-1#show vdsl interface modem-upgrade-status
PORT   STATUS  DESCRIPTION
 1.1   P       upgrade processing
 1.2   R       need reboot
 1.3   X       need upgrade
 1.4   X       need upgrade
 1.5   -       link down
 1.6   X       need upgrade
 1.7   X       need upgrade
 1.8   X       need upgrade
 2.1   -       link down
 2.2   -       link down
 2.3   -       link down
 (output truncated)
```

In the above example, the modem that is connected with VDSL Interface1.1 is on upgrading, and the other modem that is connected with VDSL Interface1.2 is finished it. But the modem must be restarted to use the upgraded modem image. The other modems have not been upgraded.

Note You must load the modem firmware image to the system buffer before you start upgrading modem image. If it is not loaded, you can show the message that the modem image is not ready and the modem image upgrade would be stopped.

Beginning in Enable mode, follow these steps to restart modem.

	Commans	**Descriptions**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vdsl interface** [*ifname*]	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**restart-modem**	Restart the modem.

Step 4	**end**	Return to Enable mode.

VDSL Modem can have two bank to store modem image. When you upgrade modem image, the upgraded modem image is stored at the bank selected alternatively. And the new upgraded modem image is activated automatically. Normally you don't need specify which modem image is activate. But, if you want to downgrade modem image, you can set the already stored modem image to be activate manually.

Beginning in Enable mode, follow these steps to set the specified modem image to be activate.

	Commands	**Descriptions**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vdsl interface** *ifname*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**activate modem-image later** or **activate modem-image now**	Change the activated modem image. Whenever you enter this command, the activated modem image would be changed alternatively. For **later**, means changing only activated image not restarting modem. For **now**, means changing activated image and restarting modem.
Step 4	**end**	Return to Enable mode.
Step 5	**show vdsl interface [*ifname*] modem-image**	Verify modem image information of the specified VDSL interface.

This example shows how to change the activating modem image of VDSL interface 1.1 and verify the results.

```
DUT-1#show vdsl interface 1.1 modem-image
Interface 1.1
 ID    STATUS    VERSION
```

```
  1    R,A       1.0.4r9
  2              1.0.4r12

*. R: running image, A: activated image
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl interface 1.1
DUT-1(config-vdsl-if)#activate modem-image later
DUT-1(config-vdsl-if)#end
DUT-1#show vdsl interface 1.1 modem-image
Interface 1.1
 ID    STATUS    VERSION
  1    R        1.0.4r9
  2    A        1.0.4r12

*. R: running image, A: activated image
DUT-1#
```

You can find the activate modem image is changed after entering the **activate modem-image** command in interface configuration mode.

5.3 Configuring VDSL Configuration Profile

These sections describe how to configure VDSL configuration profile.

- ✓ Concept of VDSL Configuration Profile
- ✓ Default Configuration of VDSL Configuration Profile
- ✓ Creating New VDSL Configuration Profile
- ✓ Deleting VDSL Configuration Profile
- ✓ Configuring VDSL Configuration Profile
- ✓ Displaying the Information of VDSL Configuration Profile

Concept of VDSL Configuration Profile

Provisioning every parameters on every VDSL interface may become burdensome. Moreover most lines are provisioned identically with the same set of parameters. To simplify the provisioning process, VX-MD3024 system makes use of VDSL configuration profiles. A profile is a set of parameters that can be shared by multiple lines using the same configuration.

VDSL configuration profile consists of the transmit rate of upstream and downstream, target SNR margin, Band Plan, and so on.

On VDSL System, one or more VDSL interfaces may be configured to share parameters of a single profile by applying a VDSL configuration profile to VDSL interface. If you apply a VDSL configuration profile to a VDSL interface, the interface refer to the parameters those are defined in VDSL configuration profile when the interface try to link on. If you apply new VDSL configuration profile to the interface of which link status is on, the interface retry to link on with new applied parameters.

Default Configuration of VDSL Configuration Profile

The following table shows the default VDSL configuration profile.

Feature	Default Setting
VDSL configuring profile name	default
Band Plan	998-640-30000 100/100
Configuring Mode	ISDN safe Mode
DSL Mode	Slow Only
Rate Adaptive Mode	Startup
UPBO Status	Off
RFI Notch Status	None
PSD Mask Label	ANNEX-F

Feature	Default Setting	
	Downstream	Upstream
Fast Channel Max. Transmit rate	100032 kbps	100032 kbps
Slow Channel Max. Transmit rate	100032 kbps	100032 kbps
Fast Channel Min. Transmit rate	64 kbps	64 kbps
Slow Channel Min. Transmit rate	64 kbps	64 kbps
Target SNR Margin	6.0 dB	6.0 dB
Min. SNR Margin	5.0 dB	5.0 dB

Max. interleave delay	2.0 ms	2.0 ms

Creating New VDSL Configuration Profile

Beginning in Enable mode, follow these steps to create new VDSL configuration profile.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vdsl conf-profile** *profile-name*	Identify a specific configuration profile for configuration, and enter VDSL configuration profile mode. If the specified configuration profile is not exist in your system, a new configuration profile would be created.
Step 3	**end**	Return to Enable mode.
Step 4	**show vdsl** *conf-profile-list*	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to create new VDSL configuration profile as "*example*".

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl conf-profile example
% vdsl conf-profile "example" is newly created
DUT-1(config-conf-profile)#end
DUT-1#show vdsl conf-profile-list
-------+-----------------------------------------
 INDEX | PROFILE NAME
-------+-----------------------------------------
    01 | default
    02 | example
```

```
-------+----------------------------------------
DUT-1#write memory
[OK]
DUT-1#
```

Note When you enter VDSL configuration profile mode, you can show the message that inform you that a new VDSL configuration profile is created. That means the specified configuration profile is not exist on the system and a new configuration profile is created. No message shown means the specified configuration profile is exist.

Deleting VDSL Configuration Profile

Beginning in Enable mode, follow these steps to delete VDSL configuration profile.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**no vdsl conf-profile** *profile-name*	Delete the specified VDSL configuration profile
Step 3	**end**	Return to Enable mode.
Step 4	**show vdsl conf-profile-list**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to delete a VDSL configuration profile as “example”

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no vdsl conf-profile example
DUT-1(config)#end
DUT-1#show vdsl conf-profile-list
-------+----------------------------------------
```

```
 INDEX | PROFILE NAME
-------+----------------------------------------
   01 | default
-------+----------------------------------------
DUT-1#write memory
[OK]
DUT-1#
```

Configuring VDSL Configuration Profile

Beginning in Enable mode, follow these steps to configure VDSL configuration profile.

The following steps show the procedure to change every configuration items of VDSL configuration profile, you can use selectively for only needed items during step 3 to step 12.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vdsl conf-profile** *profile-name*	Identify a specific configuration profile for configuration, and enter VDSL configuration profile mode. If the specified configuration profile is not exist in your system, a new configuration profile would be created.
Step 3	**base** *profile-name*	Copy VDSL configuration profile from other configuration profile. For *profile-name*, means the name of the source configuration profile.
Step 4	**band-plan** *plan-name*	Set Band-Plan. For *plan-name*, specify the type of band plan.
Step 5	**band-config { adsl-safe-mode | isdn-safe-mode | all-tone }**	Configure band configuration. For *adsl-safe-mode*, means that the line does not use

		ADSL band (138kHz to 1.1MHz). For *isdn-safe-mode*, means that the line does not use ISDN frequency band (138kHz to 640kHz). For *all-tone*, means that the line use all of frequency band.
Step 6	**rate-adaptive** or **no rate-adaptive**	Enable rate-adaptive mode. or Disable rate-adaptive mode..
Step 7	**rfi-notch** *band-name* or **no rfi-notch** *band-name*	Enable RFI notch. For *band-name*, specify the RFI notch band. Disable RFI notch.
Step 8	**psd-mask-level** *psd-mask-level*	Set PSD mask level. For *psd-mask-level*, enter PSD mask level: **annex-f, ansi-m1-cab, ansi-m1-ex, ansi-m2-cab, ansi-m2-ex, default-psd, etsi-mi-cab, etsi-m2-cab**
Step 9	**upbo** or **no upbo**	Enable UPBO (Upstream Power Back-Off). or Disable UPBO
Step 10	**data-rate {downstream | upstream} {slow-channel | fast-channel}** *max-data-rate min-data-rate*	Configure the maximum data rate and minimum data rate of the slow channel or fast channel. For max-data-rate, specify the maximum data rate. The range is 0 to 200000kbps. For min-data-rate, specify the minimum data rate. The range is 0 to 200000kbps
Step 11	**snr-margin {downstream | upstream}** *target-snr-margin min-snr-margin*	Configure target SNR margin and minimum SNR margin of each direction of the VDSL line. For *target-snr-margin*, specify target SNR margin. The range is 0 to 31.0 dB For *min-snr-margin*, specify minimum SNR margin. The range is 0 to 31.0 dB
Step 12	**interleave-delay {downstream | upstream}**	Configure interleave delay of each direction of VDSL

	delay	interface. For delay, specify the interleaving delay. The range is 0 to 50.0ms.
Step 13	**end**	Return to Enable mode.
Step 14	**show vdsl conf-profile** *profile-name*	Verify your entries.
Step 15	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the VDSL configuration file. In this example, sets the maximum data rate of downstream slow-channel to 50000 kbps, and the minimum data rate to 64 kbps. And configures the target SNR margin to 5dB and the minimum SNR margin to 3dB.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl conf-profile example
DUT-1(config-conf-profile)#data-rate downstream slow-channel 50048 64
DUT-1(config-conf-profile)#data-rate upstream slow-channel 50048 64
DUT-1(config-conf-profile)#snr-margin downstream 5 3
DUT-1(config-conf-profile)#snr-margin upstream 5 3
DUT-1(config-conf-profile)#end
DUT-1#show vdsl conf-profile example
============================================================
 VDSL CONF PROFILE: [02]  example
------------------------------------------------------------
  BAND PLAN                 : 998-640-30000 100/100
  BAND CONFIG               : ISDN Safe Mode
  UPBO MODE                 : OFF
  RATE ADAPTATION MODE        : Startup
  PSD MASK LEVEL             : ANNEX-F
  DSL Mode                  : Slow Only
  xDSL Line Type             : xDSL-AUTO-DETECT
  DS / US Slow Max Data Rate   : 50048 kbps / 50048 kbps
  DS / US Slow Min Data Rate   :    64 kbps /    64 kbps
  DS / US Target Noise Margin  :   5.0 dB   /   5.0 dB
  DS / US Min Noise Margin     :   3.0 dB   /   3.0 dB
  DS / US Max Interleave Delay :   2.0 ms   /   2.0 ms
```

```
  DS / US Min Protection      :   0.0 usec /   0.0 usec
  RFI NOTCH                 : NONE

DUT-1#write memory
[OK]
DUT-1#
```

Displaying Information of VDSL Configuration Profile

To display the information of VDSL configuration profile, use the following commands in Enable mode.

Commands	Descriptions
show vdsl conf-profile-list	Display the VDSL configuration profile list.
show vdsl conf-profile [*profile-name*]	Display parameter values of the specified VDSL configuration profile.

This example shows how to display the VDSL configuration profile list.

```
DUT-1#show vdsl conf-profile-list
-------+-----------------------------------------
 INDEX | PROFILE NAME
-------+-----------------------------------------
   01 | default
   02 | example
   03 | maximum
-------+-----------------------------------------
```

This example shows how to display parameter values of the VDSL configuration profile named as “example”.

```
DUT-1#show vdsl conf-profile example
```

```
============================================================
 VDSL CONF PROFILE: [02]  example
------------------------------------------------------------
  BAND PLAN                 : 998-640-30000 100/100
  BAND CONFIG               : ISDN Safe Mode
  UPBO MODE                 : OFF
  RATE ADAPTATION MODE        : Startup
  PSD MASK LEVEL             : ANNEX-F
  DSL Mode                  : Slow Only
  xDSL Line Type             : xDSL-AUTO-DETECT
  DS / US Slow Max Data Rate   : 50048 kbps / 50048 kbps
  DS / US Slow Min Data Rate   :    64 kbps /    64 kbps
  DS / US Target Noise Margin  :   5.0 dB   /   5.0 dB
  DS / US Min Noise Margin     :   3.0 dB   /   3.0 dB
  DS / US Max Interleave Delay :   2.0 ms   /   2.0 ms
  DS / US Min Protection       :   0.0 usec /   0.0 usec
  RFI NOTCH                 : NONE
```

5.4 Configuring VDSL Alarm Profile

This section describes how to configure VDSL alarm profile.

- ✓ Understanding VDSL Alarm Profile
- ✓ Default Alarm Profile Configuration
- ✓ Creating VDSL Alarm Profile
- ✓ Deleting VDSL Alarm Profile
- ✓ Configuring VDSL Alarm Profile
- ✓ Displaying Information of VDSL Alarm Profile

Understanding VDSL Alarm Profile

You can configure VDSL alarm profile and apply it to each VDSL interface as VDSL configuration profile. Threshold values of the following PM monitoring counters are defined in VDSL alarm profile. The system monitors each PM counters every seconds. When a PM counter exceeds the defined threshold value, it creates alarm event.

- LOFS (Loss Of Frame Seconds)
- LOSS (Loss Of Signal Seconds)
- LOLS (Loss Of Link Seconds)
- LPRS (Loss Of Power Seconds)
- ES (Errored Seconds)
- SES (Severely Errored Seconds)
- UAS (UnAvailable Seconds)
- Init Counter

Default VDSL Alarm Profile Configuration

By default, there is one alarm profile named as “default” in the system. The following table shows the default VDSL alarm profile configuration. The parameters of “default” alarm profile are set to the following default values. If you create a new alarm profile, the parameter values of that alarm profile are set also following default values.

Feature	Default Setting
alarm profile name	default
LOFS threshold	700
LOSS threshold	700
LOLS threshold	700
LPRS threshold	700
ES threshold	700
SES threshold	700
UAS threshold	700
Init counter threshold	700

Creating VDSL Alarm Profile

Beginning in Enable mode, follow these steps to create a VDSL alarm profile.

Comands	Description

Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vdsl alarm-profile** *profile-name*	Identify a specific alarm profile for configuration, and enter VDSL alarm profile mode. If the specified alarm profile is not exist in your system, a new alarm profile would be created.
Step 3	**end**	Return to Enable mode.
Step 4	**show vdsl** *alarm-profile*	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to create new VDSL alarm profile as “example”.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl alarm-profile example
% vdsl alarm-profile "example" is newly created
DUT-1(config-alarm-profile)#end
DUT-1#show vdsl alarm-profile
ALARM PROFILE NAME | LOFS LOSS LOLS LPRS   ES  SES  UAS InitFailureNoti
default            |  700  700  700  700   700  700  700 Disable
example            |  700  700  700  700   700  700  700 Disable

DUT-1#write memory
[OK]
DUT-1#
```

Note If new alarm profile is created, a message of new profile created is shown. No message shown means already the specified alarm profile is exist.

Deleting VDSL Alarm Profile

Beginning in Enable mode, follow these steps to delete alarm profile.

	Commands	Discriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**no vdsl alarm-profile** *profile-name*	Delete a specified alarm profile. For *profile-name*, specify the name of profile for deleting.
Step 3	**end**	Return to Enable mode.
Step 4	**show vdsl alarm-profile**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to delete alarm profile named as “example”.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no vdsl alarm-profile example
DUT-1(config)#end
DUT-1#show vdsl alarm-profile
ALARM PROFILE NAME | LOFS LOSS LOLS LPRS   ES  SES  UAS InitFailureNoti
default            |  700  700  700  700   700  700  700 Disable

DUT-1#write memory
[OK]
DUT-1#
```

Configuring VDSL Alarm Profile

Beginning in Enable mode, follow these steps to configure alarm profile.

The following steps show the procedure to configure every PM counters of VDSL alarm profile. You can use selectively for only needed PM counters during step 3 to step 10.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vdsl alarm-profile** *profile-name*	Identify a specific alarm profile for configuring, and enter VDSL alarm profile mode. If the specified alarm profile is not exist in your system, a new alarm profile would be created.
Step 3	**base** *profile-name*	Copy alarm profile from other alarm profile. For *profile-name*, means the name of the source alarm profile.
Step 4	**lofs-threshold** *threshold*	Configure threshold value of LOFS.
Step 5	**loss-threshold** *threshold*	Configure threshold value of LOSS.
Step 6	**lols-threshold** *threshold*	Configure threshold value of LOLS.
Step 7	**lprs-threshold** *threshold*	Configure threshold value of LPRS.
Step 8	**es-threshold** *threshold*	Configure threshold value of ES.
Step 9	**ses-threshold** *threshold*	Configure threshold value of SES.
Step 10	**init-threshold** *threshold*	Configure threshold value of Init Counters.
Step 11	**end**	Return to Enable mode.
Step 12	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure threshold value of ES and SES to 50 for each.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl alarm-profile example
DUT-1(config-alarm-profile)#es-threshold 50
DUT-1(config-alarm-profile)#ses-threshold 50
```

```
DUT-1(config-alarm-profile)#end
DUT-1#write memory
[OK]
DUT-1#
```

Displaying Information of VDSL Alarm Profile

To display the information of configured alarm profile, use the following command in Enable mode.

Commands	Description
show vdsl alarm-profile [*profile-name***]**	Display the information of specified alarm profile.

The following is an example displaying VDSL alarm profile named as “example”.

```
DUT-1#show vdsl alarm-profile example
ALARM PROFILE NAME | LOFS LOSS LOLS LPRS   ES  SES  UAS InitFailureNoti
default            |  700  700  700  700   700  700  700 Disable
```

5.5 Upgrading VDSL Modem Image

This section describes how to upgrade VDSL modem.

- ✓ Understanding Modem Upgrade
- ✓ Configuring Automatic Modem Upgrade
- ✓ Configuring Manual Modem Upgrade

Understanding Modem Upgrade

There will be a demand of upgrading modem image depending on improvement of modem performance or inter-operability problem that is caused by upgrading VDSL system's firmware.

Two kind of modem upgrading methods are supported by VX-MD3024 system. The one is automatic modem upgrade and the other is manual modem upgrade.

To upgrade vdsl modem image, first you should download modem image to system by using FTP or TFTP from remote server that the modem image is located in.

After downloading the modem image, you must load the downloaded modem image to the vdsl buffer located in the vdsl device driver. The modem upgrade process is able to use only the modem image stored in vdsl buffer.

After loading the modem image, you can upgrade the modem image automatically or manually. When you enable the automatic modem upgrade function, your system automatically starts to upgrade all of modem sequentially. If you don't enable automatic modem upgrade function, you should enter the command for manual modem upgrade.

Note When the modem image upgrading procedure have finished, the new modem image is stored at one of two banks in the modem. And the status of new modem image becomes activate status. The

activate modem image will be used at booting time of modem. If you want for the modem to be operated with upgraded modem image, restart the modem.

Configuring Automatic Modem Upgrade

After loading modem image to upgrade and enable automatic modem upgrade function, the system starts automatic modem upgrade for modems those are connected with each VDSL line. The system compares loaded modem image and the current modem image, upgrades the modem that has not same modem image automatically. If a modem image is not loaded at vdsl buffer in device driver, automatic modem upgrade function does not start although you enable automatic modem upgrade function. By default, the automatic modem upgrade function is not enabled.

Beginning in Enable mode, follow these steps to configure automatic modem upgrade function.

	Commands	Description
Step 1	**copy cpe-os-image tftp** *server-ip src-filename dest-filename* or **copy cpe-os-image ftp** *server-ip user-id password src-filename dest-filename*	Download modem image from remote FTP server. or Download modem image from remote TFTP server.
Step 2	**configure terminal**	Enter global configuration mode.
Step 3	**vdsl prepare-modem-image *filename***	Loading Modem Image
Step 4	**vdsl auto-modem-upgrade**	Enable automatic modem upgrade function.
Step 5	**end**	Return to Enable Mode
Step 6	**show vdsl modem-upgrade [*detail*]**	Verify modem upgrading status.

This example shows how to prepare modem image and enable automatic modem upgrade function.

```
DUT-1#copy cpe-os-image tftp 10.10.10.10 sample-image cpeImage
```

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl prepare cpeImage
DUT-1(config)#vdsl auto-modem-upgrade
DUT-1(config)#end
DUT-1#show vdsl modem-upgrade detail
-------------------------------------------------------
 AUTOMATIC MODEM UPGRADE :  ENABLED
 MODEM IMAGE VERSION    :  1.0.4r9
-------------------------------------------------------
 PORT   STATUS  DESCRIPTION
  1.1   O      upgrade done
  1.2   X      need upgrade
  1.3   X      need upgrade
  1.4   X      need upgrade
  1.5   -      link down
  1.6   X      need upgrade
(Output Truncated)
  3.5   X      need upgrade
  3.6   X      need upgrade
  3.7   X      need upgrade
  3.8   O      upgrade done
-------------------------------------------------------
DUT-1#
```

Configuring Manual Modem Upgrade

Beginning in Enable mode, follow these steps to start modem upgrade function manually.

	Commands	Descriptions
Step 1	**copy cpe-os-image tftp** *server-ip src-filename dest-filename* or **copy cpe-os-image ftp** *server-ip user-id*	Download modem image from remote FTP server. or Download modem image from remote TFTP server.

	password src-filename dest-filename	
Step 2	**configure terminal**	Enter global configuration mode.
Step 3	**vdsl prepare-modem-image** *filename*	Load modem image to vdsl buffer in device driver.
Step 4	**vdsl interface** *ifname*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 5	**upgrade-modem-image**	Start modem upgrade manually.
Step 6	**end**	Return to Enable mode
Step 7	**show vdsl interface** [*ifname*] **modem-upgrade-status**	Verify modem upgrade status.

This example shows how to prepare modem image and start modem upgrade manually.

```
DUT-1#copy cpe-os-image tftp 10.10.10.10 sample-image cpeImage
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl prepare cpeImage
DUT-1(config)#vdsl interface 1.1
DUT-1(config-vdsl-if)#upgrade-modem-image
DUT-1(config-vdsl-if)#end
DUT-1#show vdsl interface 1.1 modem-upgrade-status
PORT   STATUS  DESCRIPTION
  3.8   P      upgrade processing
DUT-1#
```

5.6 Configuring VDSL System Environments

This section describes how to configure VDSL system environments.

- ✓ Configuring Unit of EWL (Electrical Wire Length)
- ✓ Initializing BME

Configuring Unit of EWL (Electrical Wire Length)

EWL means the distance calculated by using electrical characteristics between system and VDSL modem. Thus this value can be differences from real distance depending on the electrical quality of lines. You can show EWL information in output displayed by the **show vdsl interface** command in Enable mode. You can configure the unit of EWL to meter or feet. By default, the default EWL unit is meter.

Beginning in Enable mode, follow these steps to configure the unit of EWL.

	Commands	Descriptions
Step 1	**configure terminal**	Enter to global configuration mode.
Step 2	**vdsl ewl-display** *unit*	Configure the unit of EWL.
Step 3	**end**	Return to Enable mode.
Step 4	**show vdsl ewl-display**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the unit of EWL as feet.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
DUT-1(config)#vdsl ewl-display feet
DUT-1(config)#end
DUT-1#show vdsl ewl-display
- EWL display unit is feet
DUT-1#
```

Initializing BME

When a VDSL line card put into mal-functional error by software trouble, you can recover the VDSL line card by initializing BME in the line card without restarting system.

Beginning in Enable mode, follow these steps to initialize VDSL line card.

	Commands	Descriptions
Step 1	**configure terminal**	Enter to global configuration mode.
Step 2	**vdsl init-unit** *unit-number*	Initialize a VDSL line card. For *unit-number*, specify the number of the VDSL line card to inialize.
Step 3	**show vdsl unit-status**	Display the status of BME in the specified VDSL line card.
Step 4	**end**	Return to Enable mode.

This example shows how to initialize VDSL line card whose number is 3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vdsl init-unit 3
Are you sure to initialize VLB #3? (y/n):y
% VLB #3 is being initialized.
DUT-1(config)#end
DUT-1#show vdsl unit-status
VLB NUMBER    ADMIN STATUS    ATTACH STATUS    RUNNING STATUS
1             UP              O                RUN
```

```
2               UP              X               DOWN
3               UP              0               RUN
4               UP              X               DOWN
DUT-1#
```

Note It takes about 30 seconds to initialize BME. You can verify that the BME initializing procedure is finished with the **show vdsl bme-status** command. When you show the status of BME is ‘running’, the procedure is finished.

Chapter 6 Configuring Switch Port

This chapter describes the type of switch port and how to configure basic function of auto-negotiation, transmit speed, flow control etc., also how to configure maximum allowed MAC address limitation, maximum allowed number of multicast group limitation, rate limit, mirroring.

This chapter consists of these sections.

- Name of Interface
- Configuring Basic Function of Switch Port
- Configuring Switch Port
- Configuring Number of MAC Address Limit
- Configuring Number of Multicast Group Limit
- Configuring Rate Limit
- Configuring Port Mirroring
- Configuring Storm Control
- Configuring NETBEUI Filter
- Displaying and Initializing Statistic Information

6.1 Name of Interface

VX-MD3024 has 2 Gigabit uplink ports and 8 VDSL ports those are connected to switch port inside of System 1 on 1.

Gigabit ethernet port of VX-MD3204 system marked ge1 and ge2. The eight switch ports connected with VDSL port are divided into two groups. Each group has four switch ports. Therefore switch ports are marked as fe1.1, fe1.2, fe1.3, fe1.4, fe2.1, fe2.2, fe2.3 and fe2.4.

6.2 Configuring Basic Function of Switch Port

You can configure basic functions those consist of port status, speed, and so on.

These sections describe how to configure basic function of interface as:

- ✓ Default Switch Port Configuration
- ✓ Displaying Basic Functions of Switch Port
- ✓ Configuring Duplex Mode
- ✓ Configuring Port Speed
- ✓ Configuring Flow Control

Default Switch Port Configuration

The following table shows the switch port default configuration.

Feature	Default Setting
Port Status	Enabled
Flow Control	OFF
VLAN	vlan1.1 (Default VLAN)
Duplex Mode	Auto
Speed	Auto

Displaying Basic Functions of Switch Port

To display the configuration of basic function of switch port, use the following command in Enable mode.

Commands	Descriptions
show interface config status *[interface-name]*	Display the configuration of basic function of every switch port For *interface-name*, specify the switch port name to display the configuration of switch port. If you don't specify interface-name, display the configuration of every switch port.

The following is an example displaying basic configuration of every switch port.

```
DUT-1#show interface config status
ena/  speed/  link  auto    STP                          lrn  inter   max  loop
 port  link  duplex  scan  neg?   state   pause  discrd  ops  face frame  back
fe1.1  up   100M FD    SW   No   Forward         None    FA   MII  1518
fe1.2  up   100M FD    SW   No   Forward         None    FA   MII  1518
fe1.3  up   100M FD    SW   No   Forward         None    FA   MII  1518
fe1.4  up   100M FD    SW   No   Forward         None    FA   MII  1518
fe1.5  up   100M FD    SW   No   Forward         None    FA   MII  1518
(Output truncated)
  ge1  up   100M FD    SW   Yes  Forward         None    FA   GMII  1518
  ge2  up     1G FD    SW   Yes  Forward        None    FA   GMII  1518
DUT-1#
```

Activate Layer 2 Interface

Beginning in Enable mode, follow these steps to enable or disable a layer 2 interface.

Step 1	**configure terminal**	Enter global configuration mode.

Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface identification.
Step 3	**no shutdown** or **shutdown**	Enable layer 2 interface. or Disable layer 2 interface.
Step 4	**end**	Return to Enable mode.
Step 5	**show running-config** [*interface-name*]	Verify your entries
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to enable layer 2 interface name as fe1.1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#no shutdown
DUT-1(config-if)#end
DUT-1#show running-config interface fe1.1
interface fe1.1
 switchport
 bridge-group 1
 switchport mode access
!
DUT-1#write memory
[OK]
DUT-1#
```

Note	By default, all ports are logically activated.

Configuring Duplex Mode

Only unidirectional communication is possible on half duplex mode and bi-directional communication is possible on full duplex mode to transmit packet for two ways. By transmitting packet for two ways, Ethernet bandwidth is enlarged two times- 10Mbps to 20Mbps, 100Mbps to 200Mbps.

To configure duplex mode of Gigabit Ethernet port, use the following command in interface

configuration mode.

Commands	Descriptions
duplex {auto | full | half}	Enter the duplex parameter for the interface. The default duplex mode is auto.
no duplex	Return the interface to the default duplex setting.

If you configure the duplex mode of a specific interface to auto mode, the auto-negotiation function would be enabled and the duplex mode and speed of the interface is configured depend on the duplex mode or speed of the peer interface. To disable the auto-negotiation function, configure the duplex mode to full or half.

Note You can configure the duplex mode of only Gigabit Ethernet port on VX-MD3024 system. The other interfaces (fe1.1 ~ fe2.4) are connected to VDSL interfaces directly. Those operate according to only pre-configured mode even though you configure the duplex mode of those interfaces.

Beginning in Enable mode, follow these steps to configure duplex mode of Gigabit Ethernet ports.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface identification.
Step 3	**duplex** *{auto | full | half}*	Enter the duplex parameter for the interface. The default duplex mode is auto.
Step 4	**end**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure duplex mode of ge1 port to full.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface ge1
```

```
DUT-1(config-if)#duplex full
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

Configuring Port Speed

Ethernet interfaces on the system operate in 10, 100, 1000 Mbps. You can configure interface speed on Gigabit Ethernet Interfaces.

To configure port speed of Gigabit Ethernet interface, use the following command in interface configuration mode.

Commands	Description
bandwidth *{10m |100m|1g}*	Enter the appropriate speed parameter for the interface The default bandwidth configuration is auto.
no bandwidth	Return the interface to the default speed settings.

If you configure the speed of an interface to auto, the auto-negotiation function would be enabled and the duplex mode and speed of the interface is configured depend on the duplex mode or speed of the peer interface. To disable the auto-negotiation function, configure the speed to 10M, 100M or 1G.

Beginning in Enable mode, follow these steps to configure port speed of Gigabit Ethernet port.

	Commands	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface identification.
Step 3	**bandwidth** *{10M | 100M | 1G}*	Enter the appropriate speed parameter for the interface The default bandwidth configuration is auto.
Step 4	**end**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure port speed of ge1 port to 100 Mbps.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface ge1
DUT-1(config-if)#bandwidth 100m
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

Configuring Flow Control

Flow control enables connected Ethernet ports to control traffic rates during congestion by allowing congested nodes to pause link operation at the other end. If one port experiences congestion and cannot receive any more traffic, it notifies the other port to stop sending until the condition clears. When the local device detects any congestion at its end, it can notify the link partner or the remote device of the congestion by sending a pause frame. Upon receipt of a pause frame, the remote device stops sending any data packets, that prevents any loss of data packets during the congestion period.

To configure flow control an interface, use the following command in interface configuration mode.

Commands	Descriptions
flowcontrol {receive|send} *{on | off}*	Configure the flow control mode for the port. **receive on** and **send on**: Flow control operates in both directions; both the local and the remote devices can send pause frames to show link congestion. **receive on** and **send off**: The port can not send pause frames but can operate with an attached device that is required to or can send pause frames; the port can receive pause frames. **receive off** and **send on**: The port sends pause frames if the remote device supports flow control but cannot receive pause frames from the remote device. **receive off** and **send off**: Flow control does not

	operate in either direction. In case of congestion, no indication is given to the link partner, and no pause frames are sent or received by either device.
no flowcontrol	Return the interface to the default flow control settings.

Beginning in Enable mode, follow these steps to configure flow control on an interface:

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.
Step 3	**flowcontrol {receive | send}** *{on | off}*	Configure the flow control mode for the port.
Step 4	**end**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to turn on all flow control on Gigabit Ethernet interface ge1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface ge1
DUT-1(config-if)#flow control receive on
DUT-1(config-if)#flow control send on
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

To display flow control status on a physical port, use the following command in Enable mode.

Commands	Descriptions
show flowcontrol interface *interface-name*	Display configured flow control status on a specified physical port.

The following is an example displaying flow control status on the interface fe1.1.

```
DUT-1#show flowcontrol interface fe1.1
Port   Send FlowControl   Receive FlowControl  RxPause TxPause
       admin   oper       admin   oper
-----  ------- --------   ------- --------     ------- -------
fe1.1   on     on          on     on              0      0
DUT-1#
```

6.3 Configuring Switch Port

Switch ports are Layer 2-only interfaces associated with a physical port. A switch port can be an access port, a trunk port, or a hybrid port

This section describes how to configure to switch port and type of switch port.

- ✓ Configuring to Switch Port
- ✓ Configuring Bridge Group
- ✓ Access Port
- ✓ Hybrid Port
- ✓ Trunk Port

Configuring to Switch Port

Each physical port of VX-MD3024 can operate as Layer 2 interface and Layer 3. By default, all physical ports on VX-MD3024 system are configured to Layer 2 mode.

Beginning in Enable mode, follow these steps to configure an interface to Layer 2 interface (switch port).

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.

Step 3	**switchport**	For physical ports only, enter Layer 2 mode.
Step 4	**end**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the fe1.1 interface to switch port.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#switchport
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

You can configure an interface to Layer 3 interface (Routed port) by using the **no switchport** command. All Layer 3 interfaces require an IP address to route traffic.

This example shows how to configure ge1 port to router port and IP address to 192.168.30.200.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface ge1
DUT-1(config-if)#no switchport
DUT-1(config-if)#ip address 192.168.30.200/24
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

Configuring Bridge Group of Switch Port

VX-MD3024 system supports fallback bridging function. With fallback bridging, the system bridges together two or more VLANs or routed ports, essentially connecting multiple VLANs within one bridge domain. Fallback bridging forwards traffic that the system does not route and forwards traffic belonging to a non-routable protocol such as DECnet.

To assign a switch port to a bridge group, use the following command in interface configuration mode.

Commands	Descriptions
bridge-group *bridge-id*	Assign the switch port to the specified bridge group.

A switch port should be assigned to only one bridge group to provide Layer 2 service. By default, all ports on VX-MD3024 system are assigned to the bridge group 1.

Note To reduce complexity of system management, it is preferable to configure only one bridge group on your system, if possible.

Access Port

An access port belongs to and carries the traffic of only one VLAN. Traffic is received and sent in native formats with no VLAN tagging. Traffic arriving on an access port is assumed to belong to the VLAN assigned to the port.

To configure a switch port to access port, use the following command in interface configuration mode.

Commands	Descriptions
switchport mode access	Configure the type of switch port to access port.
switchport mode access ingress-filter *{enable | disable}*	Enable or disable filtering function of an access port. Activating or de-Activating Filtering Function of Access Port The default value of **ingress-filter** is *disable*.

If the filtering function is enabled on an access port, it forwards only untagged frames and discards tagged frames automatically.

Beginning in Enable mode, follow these steps to configure a switch port to access port, and configure filtering function.

	Commands	Description
Step 1	**configure terminal**	Enter global configure mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.
Step 3	**switchport**	For physical ports only, enter Layer 2 mode.
Step 4	**bridge-group** *bridge-id*	Assign the switch port to a specified bridge group.
Step 5	**switchport mode access**	Configure the switch port mode to access port.
Step 6	**switchport mode access ingress-filter** *{enable | disable}*	Enable or disable ingress filtering function of the access port.
Step 7	**end**	Return to Enable mode.
Step 8	**show running-config interface** *interface-name*	Verify your entries.
Step 9	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure fe1.1 interface to access port and enable ingress filtering function of the interface.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 1
DUT-1(config-if)#switchport mode access
DUT-1(config-if)#switchport mode access ingress-filter enable
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#show running-config interface fe1.1
!
interface fe1.1
 switchport
 bridge-group 1
 switchport mode access
 switchport mode access ingress-filter enable
!
```

```
DUT-1#
```

Hybrid Port

A Hybrid port can treat both of tagged and untagged frames. A hybrid port carries the traffic of multiple VLANs. Received frames in a hybrid port are classified based on the VLAN characteristics and then accepted or discarded based on the specified filtering criteria.

To configure a switch port to hybrid port, use the following command in interface configuration mode.

Commands	Description
switchport mode hybrid	Configure a switch port mode to hybrid port.
switchport mode hybrid acceptable-frame-type *{all* | *vlan-tagged}*	Set the switch port acceptable frame types. *all*: Accept all frames received. *vlan-tagged*: Accept only classified frames which belong to the port's member set. The default value is *all*.
switchport mode hybrid ingress-filter *[{enable* | *disable}]*	Set the ingress filtering for received frames. Received frames that cannot be classified in the previous step based on the acceptable frame type parameter are discarded. The default configuration of **ingress-filter** function is *disable.*
no switchport hybrid	Reset the mode of switch port to access that is default.

On the above commands, the default value of **acceptable-frame-type** is *all* and the default value of **ingress-filter** is *disable* . Thus the result of using only the **switchport mode hybrid** command is that the ingress filtering is off, and that all frame types are classified and accepted.

Beginning in Enable mode, follow these steps to configure a switch port to hybrid port, and enable ingress filtering and configure the allowed frame types.

Commands	Description

Step 1	**configure terminal**	Enter global configure mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.
Step 3	**switchport**	For physical ports only, enter Layer 2 mode.
Step 4	**bridge-group** *bridge-id*	Assign the switch port to a specified bridge group.
Step 5	**switchport mode hybrid**	Configure the switch port mode to hybrid port.
Step 6	**switchport mode hybrid acceptable-frame-type** *{vlan-tagged* | *all}*	Configure the allowed frame type. *all*: Accept all frames received. *vlan-tagged*: Accept only classified frames which belong to the port's member set. The default value is *all*.
Step 7	**switchport mode hybrid ingress-filter** *{enable* | *disable}*	Set the ingress filtering for received frames. Received frames that cannot be classified in the previous step based on the acceptable frame type parameter are discarded. The default configuration of **ingress-filter** function is *disable.*
Step 8	**end**	Return to Enable mode.
Step 9	**show running-config interface** *interface-name*	Verify your entries.
Step 10	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure fe1.4 port to hybrid port and enable ingress filtering function. On following example, **acceptable-frame-type** is configured *all* automatically.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.4
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 1
DUT-1(config-if)#switchport mode hybrid
DUT-1(config-if)#switchport mode hybrid ingress-filter enable
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.4
```

```
!
interface fe2.4
 switchport
 bridge-group 1
 switchport mode hybrid
 switchport mode hybrid ingress-filter enable
 switchport mode hybrid acceptable-frame-type all
!
DUT-1#write memory
[OK]
DUT-1#
```

Trunk Port

A trunk port carries the traffic of multiple VLANs and supports simultaneous tagged and untagged traffic. A trunk port is assigned a default Port VLAN ID (PVID), and all untagged traffic travels on the port default PVID. All untagged traffic and tagged traffic with a NULL VLAN ID are assumed to belong to the port default PVID. A packet with a VLAN ID equal to the outgoing port default PVID is sent untagged. All other traffic is sent with a VLAN tag.

To configure switch port mode to trunk port, use the following commands on interface configuration mode.

Commands	Descriptions
switchport mode trunk	Set the switching characteristics of the switch port as trunk and specify tagged frames only
switchport mode trunk ingress-filter *[{enable | disable}]*	Set the ingress filtering for the frames received. For *enable*, set the ingress filtering for received frames. Received frames that cannot be classified based on the acceptable frame type parameter are discarded. For *disable*, turn off ingress filtering to accept frames that do not meet the classification criteria. The default value is *disable.*

no switchport trunk	Reset the mode of switch port to access that is default.

If you set the ingress filtering to enable, received frames that cannot be classified based on the acceptable frame type parameter are discarded automatically.

Beginning in Enable mode, follow these steps to configure filtering function of trunk port.

	Commands	Description
Step 1	**configure terminal**	Enter global configure mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.
Step 3	**switchport**	For physical ports only, enter Layer 2 mode.
Step 4	**bridge-group** *bridge-id*	Assign the switch port to a specified bridge group.
Step 5	**switchport mode trunk**	Configure the switch port mode to trunk port.
Step 6	**switchport mode trunk ingress-filter** *{enable | disable}*	Enable or disable ingress filtering function on the switch port.
Step 7	**end**	Return to Enable mode.
Step 8	**show running-config interface** *interface-name*	Verify your entries.
Step 9	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure fe2.4 port to trunk port and enable ingress filtering function.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.4
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 1
DUT-1(config-if)#switchport mode trunk
DUT-1(config-if)#switchport mode trunk ingress-filter enable
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.4
!
interface fe2.4
```

```
 switchport
 bridge-group 1
 switchport mode trunk
 switchport mode trunk ingress-filter enable
!
DUT-1#write memory
[OK]
DUT-1#
```

6.4 Configuring Number of MAC Address Limit

You can limit the number of users by configuring maximum number of MAC address for each port. In this case, you need to consider not only the number of PCs in network but also devices such as switches in the network. For your system, you have to lock the port like MAC filtering before configuring MAC address limit.

To limit the maximum number of users connectable to a switch port, use the following command on interface configuration mode.

Commands	Descriptions
mac limit *limit-num*	Configure the number of MAC address connectable to the specified port. The default configuration is no limitation of maximum number of MAC address.
no mac limit	Delete limitation of number of MAC address to the specified port.

This example shows how to configure limitation of number of MAC address on fe1.1 port to 4.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#mac limit 4
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

6.5 Configuring Number of Multicast Group Limit

By getting out of order a subscriber's terminal, it can be joined in many multicast group at the same line. In this event, traffic from every multicast group being joined in shall be transmitted to the connected switch port and the other traffic of subscriber can be affected by the multicast traffic. To solve this issue, you can set the maximum allowed multicast group limit per switch port on your system. If you set the maximum allowed multicast group limit, the subscriber's terminal can join only in limited number of multicast group simultaneously.

To set the maximum number of multicast group limit per switch port, use the following command on interface configuration mode.

Commands	Descriptions
multicast group-limit *limit-num*	Set the maximum allowed number of multicast group limit for the interface. By default, there is no limitation of multicast group on switch port.
no multicast group-limit	Clear the maximum allowed number of multicast group limit for the switch port.

This example shows how to set the maximum allowed multicast group limit of interface fe1.1 to 3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#multicast group-limit 3
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

6.6 Configuring Rate Limit

You can customize port bandwidth according to user's environment. Through this configuration, you can prevent a certain port to monopolize whole bandwidth so that all ports can use bandwidth equally. You can configure egress and ingress bandwidth to be same and to be different.

To configure rate limit of switch port, use the following command on interface configuration mode.

Commands	Descriptions
ratelimit {ingress | egress} bandwidth *rate* **burst** *burst-rate*	Configure the allowed bandwidth for the switch port. You can configure ingress and egress direction bandwidth separately. **ingress** configures bandwidth to input direction, **egress** configures bandwidth to output direction. **bandwidth** *rate* configures allowable average transmit rate. **burst** *burst-rate* configures allowed peak transmit rate.
no ratelimit {ingress | egress}	Clear the configured bandwidth for the switch port.

When you set the bandwidth limitation function, you can configure it for the ingress and egress direction separately. You can also configure not only maximum allowed bandwidth but also maximum allowed burst. The maximum bandwidth means allowable average data rate, and the burst means allowable peak transmit rate.

Note	When you configure bandwidth on VX-MD3024, you can configure *rate* by bps unit. Also you can use k (Kbps), m (Mbps), g (Gbps) unit for your convenience

Note	When you configure burst on VX-MD3024, you can configure burst-rate by kbps unit. You can configure Burst value to only multiples of 32kbps.

Beginning in Enable mode, follow these steps to configure maximum allowed bandwidth of a specified switch port.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configure mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.
Step 3	**ratelimit {ingress | egress} bandwidth** *rate* **burst** *burst-rate*	Limiting Bandwidth of concerned Interface. Pointing out Ingress or egress, Bandwidth to Sending and Receiving Traffic can be limited. *burst-rate can be configured for th*

		sudden increase of Traffic happened.
Step 4	**end**	Return to Enable mode.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure bandwidth limit of ingress traffic on the switch port fe1.1, and burst to 32 Kbps.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#ratelimit ingress bandwidth 10m burst 32
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

To display the configured bandwidth limit of every switch port, use the **show interface config ratelimit** command on Enable mode.

This example shows how to display the configured bandwidth limit of every switch port.

```
DUT-1#show interface config ratelimit
       Ingress    To-CPU   Egress   Pause  Resume
Port   Kbits Burst   PPS Kbits Burst Kbits  Kbits
fe1.1   10m   32
fe1.2
fe1.3
(output truncated)
DUT-1#
```

6.7 Configuring Port Mirroring

Port mirroring means that you can monitor several ports on a port. In this function, one port to monitor is called “mirror test port” and a port to be monitored is called “monitored port”. Traffics transmitted from monitored port are copied and sent to mirror test port so that you can monitor it.

To configure port mirroring on VX-MD3024, use the following command on interface configuration mode of the mirror test port.

Commands	Dscriptions
mirror interface *interface-name* **direction** *{both* | *receive* | *transmit}*	Configure port mirroring. For *interface-name*, specify monitored port. For **direction** *{both* | *receive* | *transmit},* select the direction of traffic to monitor.
no mirror interface *interface-name* **[direction** *{receive*|*transmit}***]**	Delete monitored port. You can delete the monitored port about the specified direction with **direction** keyword.

Beginning in Enable mode, follow these steps to enable port mirror.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configure mode.
Step 2	**interface** *interface-name*	Enter interface configuration mode and the physical interface to be configured.
Step 3	**mirror interface** *interface-name* **direction** *{both* | *receive* | *transmit}*	Configuring Interface and Traffic Direction for Monitoring
Step 4	**end**	Return to Enable mode.
Step 5	**show mirror**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure port mirror function. In this example, interface ge2 is mirror test port and interface fe1.1 and fe1.2 is monitored port.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface ge2
DUT-1(config-if)#mirror interface fe1.1 direction receive
DUT-1(config-if)#mirror interface fe1.2 direction receive
DUT-1(config-if)#end
DUT-1#show mirror
```

```
------------------------------------------------------------
Mirror Test Port Name: ge2
Mirror option: Enabled
Mirror direction: receive
Monitored Port Name: fe1.1
------------------------------------------------------------
Mirror Test Port Name: ge2
Mirror option: Enabled
Mirror direction: receive
Monitored Port Name: fe1.2
------------------------------------------------------------

DUT-1#write memory
[OK]
DUT-1#
```

6.8 Configuring Storm Control

Storm control prevents switch ports on a LAN from being disrupted by a broadcast, multicast, or unicast storm on one of the physical interfaces. A LAN storm occurs when packets flood the LAN, creating excessive traffic and degrading network performance. Errors in the protocol-stack implementation or in the network configuration can cause a storm.

Storm control (or traffic suppression) monitors incoming traffic statistics over a time period and compares the measurement with a predefined suppression level threshold. The threshold represents the percentage of the total available bandwidth of the port. The system supports separate storm control thresholds for broadcast, multicast, and unicast traffic. If the threshold of a traffic type is reached, further traffic of that type is suppressed until the incoming traffic falls below the threshold level.

By default, unicast, broadcast, and multicast storm control is disabled on the system; that is, the suppression level is 100 percent (no limit is placed on the traffic).

Beginning in Enable mode, follow these steps to enable a particular type of storm control:

	Commands	Description
Step 1	**configure terminal**	Enter global configuration mode.

Step 2	**interface** *interface-name*	Specify the type and number of the physical interface to configure, and enter interface configuration mode.
Step 3	**storm-control broadcast level** *level[.level]*	Specify the broadcast traffic suppression level for an interface as a percentage of total bandwidth. The level can be from 1 to 100; the optional fraction of a level can be from 0 to 99. A threshold value of 100 percent means that no limit is placed on broadcast traffic.
Step 4	**storm-control multicast level** *level[.level]*	Specify the multicast traffic suppression level for an interface as a percentage of total bandwidth. The level can be from 1 to 100; the optional fraction of a level can be from 0 to 99. A threshold value of 100 percent means that no limit is placed on multicast traffic.
Step 5	**storm-control dlf level** *level[.level]*	Specify the DLF (Destination Lookup Failure) traffic suppression level for an interface as a percentage of total bandwidth. The level can be from 1 to 100; the optional fraction of a level can be from 0 to 99. A threshold value of 100 percent means that no limit is placed on multicast traffic.
Step 6	**end**	Return to Enable mode
Step 7	**show storm-control** *[interface-name]*	Verify the storm control suppression levels set on the interface for the specified traffic type. If you do not enter a traffic type, broadcast storm control settings are displayed.
Step 8	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure Multicast Storm control value to fe1.1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#storm-control multicast level 70.5
DUT-1(config-if)#end
DUT-1#show storm-control fe1.1
Port    BcastLevel BcastDiscards McastLevel McastDiscards DlfLevel DlfDiscards
--------------------------------------------------------------------------------
fe1.1      100. 0%          0      70. 5%          0      100. 0%       0
```

To disable storm control, use the following command on interface configuration mode.

Commans	Descriptions
no storm-control broadcast level	Disable broadcast storm control function.
no storm-control multicast level	Disable multicast storm control function.
no storm-control unicast level	Disable unicast storm control function.

This example shows how to disable multicast storm control on interface fe1.1 and verify the configuration.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#no storm-control multicast level
DUT-1(config-if)#end
DUT-1#show storm-control fe1.1
Port    BcastLevel BcastDiscards McastLevel McastDiscards DlfLevel DlfDiscards
------- ----------  ------------ ---------- ------------ -------- ----------
fe1.1      100. 0%           0     100. 0%           0       100. 0%        0
```

6.9 Configuring NETBEUI Filter

NetBIOS is used at LAN (Local Area Network) environment where should share information with each other to communicate between computers. However, in case ISP(Internet Service Provider) provides internet communication through LAN service to specific area such as apartments, customer's information should be kept.

In this case, without NetBIOS filtering, customers' data may be opened to each other even though the data should be kept. In order to keep customer's information and prevent sharing information in the above case, NetBIOS filtering is necessary.

Beginning in Enable mode, follow these steps to enable NetBEUI/NetBIOS filtering function.

Commans	Descriptions

Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Specify the type and number of the physical interface to configure, and enter interface configuration mode.
Step 3	**netbeui-filtering**	Enable NetBEUI filtering function.
Step 4	**nbipx-filtering**	Enable NetBIOS filtering function.
Step 6	**end**	Return to Enable mode.
Step 7	**show running-config interface** *[interface-name]*	Verify your entries.
Step 8	**write memory**	(Optional) Save your entries in the configuration mode.

This example shows how to enable NetBEUI and NetBIOS filter on switch port fe1.1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#netbeui-filtering
DUT-1(config-if)#nbipx-filtering
DUT-1(config-if)#end
DUT-1#show running-config interface fe1.1
!
interface fe1.1
switchport
 bridge-group 1
 switchport mode access
 nbipx-filtering
 netbeui-filtering
!
```

To disable NetBEUI and NetBIOS filter, use the following command on interface configuration mode.

Commands	Description
no netbeui-filtering	Disable NetBEUI filter.
no nbipx-filtering	Disable NetBIOS filter.

This example shows how to disable NetBEUI and NetBIOS filter.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#no netbeui-filtering
DUT-1(config-if)#no nbipx-filtering
DUT-1(config-if)#end
DUT-1#show running-config interface fe1.1
!
interface fe1.1
 switchport
 bridge-group 1
 switchport mode access
!
```

6.10 Displaying and Initializing Statistic Information

You can show the average traffic load and counters per port on your system. And you can show also the other counters that are defined in IF-MIB and RMON-MIB. You can clear the interface counters

This section describes following items concerning to displaying on static information and Initializing Function

- ✓ Displaying Traffic Load
- ✓ Displaying Raw Counters per SNMP Standard Group
- ✓ Initializing Statistic Information

Displaying Traffic Load

You can show the average traffic load of each interface.

To display average traffic load of each interface, use the following command on Enable mode.

Command	Description
show interface statistics packet-rate *interface-name*	Display average traffic load of a specified interface.

This example shows how to display average traffic load of interface ge1.

```
DUT-1#show interface statistics packet-rate ge1
=============================================================================
ge1    :     Packets(In)       Bits(In)    Packets(Out)       Bits(Out)
-----------------------------------------------------------------------------
  5 sec:             10        115,808              9        115,096
  1 min:             11        116,608              9        115,104
 10 min:              4         28,760              2         26,944
=============================================================================
DUT-1#
```

Displaying Raw Counters per SNMP Standard Group

You can show the raw packet counters classified by SNMP MIB type. The packet counter information that you can get with the show interface statistics counters command and the traffic load information that you can get with the show interface statistics packet rate command are provided by calculating count value of these raw counters.

To display raw packet counters per SNMP standard group, use the following command on Enable mode.

Commands	Description
show interface statistics *interface-name*	Display raw packet counters of each kind of SNMP MIB group of specified port.
show interface statistics snmp *{additional | rfc1213 | rfc1493 | rfc1757 | rfc2233 | rfc2665} interface-name*	Display raw packet counters of specified SNMP MIB group of the port. You can specify SNMP MIB group with following type: rfc1213: IF-MIB in the MIB-II rfc1493: Bridge-MIB rfc1757: RMON-MIB rfc2233: IF-MIB using SMIv2 rfc2665: EtherLike-MIB additional: Out of SNMP Standard

This example shows how to display raw packet counters that are defined on rfc1213 of interface ge1.

```
DUT-1#show interface statistics snmp rfc1213 ge1
           Interface  ge1:                In                Out
                IfOctets:          110114394          86959115
              IfUcastPkts:              65351             63867
             IfNUcastPkts:             255389              1738
               IfDiscards:              19811                 0
                 IfErrors:                  0                 0
```

Initializing Statistic Information

You can clear the raw packet counter classified by SNMP MIB group. All traffic counter and average traffic load information provided by VX-MD3024 system is calculated with these raw packet counters: thus if you clear the raw packet counters, the counter information and traffic load information would be cleared at the same time.

To clear raw packet counters per SNMP MIB group, use the following command on Enable mode.

Command	Description
clear interface statistics snmp *interface-name*	Clear the raw packet counters of a interface.

This example shows how to clear raw packet counters of interface ge1.

```
DUT-1#clear interface statistics snmp ge1
DUT-1#
```

Chapter 7 Configuring VLAN

This chapter describes how to create and delete VLAN and also to add or delete port to a VLAN.

This chapter consists of these sections.

- Understanding VLAN
- Default VLAN Configuration
- Creating or Modifying VLAN
- Deleting a VLAN
- Assigning Ports to a VLAN
- Displaying VLANs

7.1 Understanding VLAN

Nodes in same LAN can receive information when one node sends the information by using Broadcast. However, with using the Broadcast, node is supposed to be obliged to receive unnecessary information. To prevent this defect, nodes on same logical LAN are supposed to receive the information by dividing LAN into logical LAN.

Like this, logically divided LAN is called as VLAN (Virtual LAN) and one VLAN may include several ports. Packets can be transmitted between ports in same VLAN when network is consisted of VLAN. Only through routing equipment to make connection in VLANs, packets can be transmitted between ports in each different VLAN. VLAN decreases Ethernet traffic to improve transmit rate and strengthens security by transmission per VLAN.

You can construct VLAN based on port, MAC address, and protocol. VX-MD3024 system supports port based VLAN. VX-MD3024 system complying with IEEE 802.1q can transmit both tagged packet and untagged packet. Untagged packet does not have VLAN ID. All switch ports have VLAN ID (PVID) configured by system. So, unless user configures specific VLAN, known as untagged VLAN, system configures VLAN ID (PVID). Therefore, switch ports, which consist VLAN network can transmit packet to the VLAN, which has same number with VLAN number.

All ports in the system shall be distinguished into access port, hybrid port and trunk port depending on the kind of packets basically treated. Generally access port treats only untagged packet and trunk port treats only tagged packet. And hybrid port can treat both of tagged packet and untagged packet. But these differences are depend on only packet processing method. If you do not enable VLAN filtering function, both tagged packet and untagged packet would be processed.

7.2 Default VLAN Configuration

By default, all switch ports of VX-MD3024 are belonging to the default VLAN and the default VLAN is included in bridge group 1 and the VLAN ID of the default VLAN is 1. The name of all the VLAN created from system shall be basically VLAN*vlanId*. If you create a VLAN those ID is 10 without appointment of VLAN name, automatically the name of the VLAN shall be VLAN0010.

7.3 Creating or Modifying VLAN

Beginning in Enable mode, follow these steps to create or modify a VLAN:

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vlan database**	Enter VLAN configuration mode.
Step 3	**vlan** *vlan-id* **bridge** *bridge-id* **[name** *vlan-name***]**	Add a VLAN by assigning a number to it. The range is 2 to 4094. If no name is entered for the VLAN, the default is to append the vlan-id with leading zeros to the word VLAN. For example, VLAN0004 is a default VLAN name for VLAN 4.
Step 4	**vlan** *vlan-id* **bridge** *bridge-id* **state** *{active | suspend}*	Configure the status of VLAN. For **state** *{active | suspend}*, set the status of the VLAN. The VLAN those status is suspend do not forward packets.
Step 5	**end**	Return to Enable mode.
Step 6	**show vlan brief**	Verify your entries.
Step 7	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to create VLAN 250 and configure name of VLAN as of *test_vlan*.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vlan database
DUT-1(config-vlan)#vlan 250 bridge 1 name test_vlan
DUT-1(config-vlan)#end
DUT-1#
```

7.4 Deleting a VLAN

When you delete a VLAN from a system, you should delete the ports consist of the VLAN first. If you delete a VLAN that has assigned ports, the ports are automatically moved to the default VLAN. The default VLAN cannot be deleted.

Beginning in Enable mode, follow these steps to delete a VLAN on the system.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**vlan database**	Enter VLAN configuration mode.
Step 3	**no vlan** *vlan-id* **bridge** *bridge-id*	Remove the VLAN by entering the VLAN ID.
Step 4	**end**	Return to Enable mode.
Step 5	**show vlan brief**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries the configuration file.

This example shows how to delete VLAN 250.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#vlan database
DUT-1(config-vlan)#no vlan 250 bridge 1
DUT-1(config-vlan)#end
DUT-1#
```

7.5 Assigning Ports to a VLAN

By default, all switch ports are assigned to the default VLAN. When you assign a switch port to a VLAN, it is automatically removed from the default VLAN.

The way of assigning ports to VLAN is depending on the kind of switch port. This section describes as follows:

- ✓ Configuring Access port
- ✓ Configuring Hybrid port
- ✓ Configuring Trunk port
- ✓ Configuring Native VLAN of Trunk port
- ✓ Confirming VLAN

Configuring Access port

An access port belongs to only one VLAN. Traffic is received and sent in native formats with no VLAN tagging. Traffic arriving on an access port is assumed to belong to the VLAN assigned to the port. When it is not enabled VLAN filtering function of the switch port, tagged packets also permit. Tagged packet shall be classified by using VLAN ID value specified in VLAN tag.

Beginning in Enable mode, follow these steps to assign an access port to a VLAN.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter the interface to be added to the VLAN.
Step 3	**switchport**	For physical ports only, enter Layer 2 mode.
Step 4	**bridge-group** *bridge-id*	Assign the switch port to a specified bridge group.
Step 5	**switchport mode access**	Define the VLAN membership mode for the port (Layer 2 access port)
Step 6	**switchport vlan access** *vlan-id*	Assign the port to a VLAN. Valid VLAN IDs are 2 to 4094; do not enter leading zeros.
Step 7	**end**	Return to Enable mode.
Step 8	**show running-config interface** *interface-name*	Verify your entries.
Step 9	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure switch port fe1.1 to access port and to assign it to VLAN 100.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 1
DUT-1(config-if)#switchport mode access
DUT-1(config-if)#switchport access vlan 100
DUT-1(config-if)#end
DUT-1#
```

Configuring Hybrid Port

A hybrid port can process both of untagged and tagged packets. All tagged packet entered into hybrid port shall be classified depend on VLAN ID specified on tag field. And untagged packet entered into hybrid port shall be classified to the configured VLAN for the hybrid port.

To configure the default VLAN of a hybrid port, use the following command

Commands	Descriptions
switchport hybrid vlan *vlan-id*	Set default VLAN ID of a hybrid port. By default, the default VLAN ID of a hybrid port is 1 (system default VLAN).
no switchport hybrid vlan	Remove the default VLAN ID of a hybrid port. At this time the default VLAN ID of the hybrid port becomes 1.

A hybrid port can be assigned several VLANs with tagged or untagged characteristics. Thus a hybrid port can process tagged and untagged packet. To configure allowed VLAN of hybrid port, use the following command on interface configuration mode.

Commands	Descriptions

switchport hybrid allowed vlan all	Allow all VLANs to transmit and receive through the hybrid port.
switchport hybrid allowed vlan none	Allow no VLANs to transmit and receive through the hybrid port.
switchport hybrid allowd vlan add *vlan-id* **egress-tagged** *{enable | disable}*	Add a VLAN to the member set. For **egress-tagged** *{enable|disable}*, configure the egress packet from a hybrid port to be untagged or tagged packet.
switchport hybrid allowd vlan remove *vlan-id*	Remove a VLAN from the member set.

Beginning in Enable mode, follow these steps to configure the member set of a hybrid port.

	Commands	Descriptions
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-name*	Enter the interface to be added to the VLAN.
Step 3	**switchport**	For physical ports only, enter Layer 2 mode.
Step 4	**bridge-group** *bridge-id*	Assign the switch port to a specified bridge group.
Step 5	**switchport mode hybrid**	Configure the switch port's mode to hybrid.
Step 6	**switchport vlan hybrid** *vlan-id*	Set the default VLAN of the hybrid port.
Step 7	**switchport vlan hybrid allowed vlan add** *vlan-id* **egress-tagged** *{enable | disable}*	(Optional) Add a VLAN to the member set. For **egress-tagged** *{enable|disable}*, configure the egress packet from a hybrid port to be untagged or tagged packet.
Step 8	**switchport vlan hybrid allowed vlan remove** *vlan-id*	(Optional) Remove a VLAN from the member set.
Step 9	**end**	Return to enable mode.
Step 10	**show running-config interface** *interface-name*	Verify your entries.
Step 11	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure interface fe1.1 to hybrid port and to set its default VLAN ID to 100.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.1
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 1
DUT-1(config-if)#switchport mode hybrid
DUT-1(config-if)#switchport hybrid vlan 100
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.1
!
interface fe2.1
 switchport
 bridge-group 1
 switchport mode hybrid
 switchport hybrid vlan 100
 switchport mode hybrid acceptable-frame-type all
 switchport hybrid allowed vlan add 100 egress-tagged disable
!
DUT-1#
```

This example shows how to add VLAN 100 to the member set of the hybrid port fe1.1 and to configure VLAN Tag to be added when the packets belong to the VLAN are exported.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.1
DUT-1(config-if)#switchport hybrid allowed vlan add 10 egress-tagged enable
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.1
!
interface fe2.1
 switchport
 bridge-group 1
 switchport mode hybrid
 switchport hybrid vlan 100
 switchport mode hybrid acceptable-frame-type all
 switchport hybrid allowed vlan add 10 egress-tagged enable
 switchport hybrid allowed vlan add 100 egress-tagged disable
!
```

```
DUT-1#
```

Configuring Trunk Port

A trunk port basically processes only tagged packet. And a trunk port can be assigned to the multiple VLANs at the same time. All packets from trunk port shall be output with VLAN tag.

To configure the VLAN member set of a trunk port, use the following command.

Commands	Descriptions
switchport trunk allowed vlan all	Allow all VLANs to transmit and receive through the trunk port.
switchport trunk allowed vlan none	Allow no VLANs to transmit and receive through the trunk port.
switchport trunk allowd vlan add *vlan-id*	Add a VLAN to transmit and receive through the trunk port.
switchport trunk allowd vlan remove *vlan-id*	Remove a VLAN from transmit and receive through the trunk port.
switchport trunk allowd vlan except *vlan-id*	All VLANs, except the VLAN for which the ID is specified, are part of its ports member set.

This example shows how to configure interface fe1.1 to trunk port and configure allowed VLAN member set.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.1
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 1
DUT-1(config-if)#switchport mode trunk
DUT-1(config-if)#switchport trunk allowed vlan add 10
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.1
!
interface fe2.1
 switchport
```

```
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan add 10
!
DUT-1#
```

This example shows how to remove VLAN 10 from the VLAN member set of interface fe2.1

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.1
DUT-1(config-if)#switchport trunk allowed vlan remove 10
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.1
!
interface fe2.1
 switchport
 bridge-group 1
 switchport mode trunk
!
DUT-1#
```

Configuring Native VLAN of Trunk port

If VLAN filter function of a trunk port is not enabled, the trunk port can process untagged packet also. But when the trunk port receives untagged packets, the trunk port cannot decide those VLAN ID. To solve this problem, you can configure native VLAN.

To configure native VLAN, use the following command on interface configuration mode.

Commands	Descriptions
switchport trunk native vlan *vlan-id*	Specify the native VLAN for trunk port.
no switchport trunk native vlan	Delete the configured native VLAN.

This example shows how to add VLAN 100 to the VLAN member set of trunk port fe2.1, and specify native VLAN to VLAN 100.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe2.1
DUT-1(config-if)#switchport trunk allowed vlan add 100
DUT-1(config-if)#switchport trunk native vlan 100
DUT-1(config-if)#end
DUT-1#show running-config interface fe2.1
!
interface fe2.1
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan add 100
 switchport trunk native vlan 100
!
DUT-1#
```

Displaying VLAN

To display a list of all VLANs on your system, use the following command on Enable mode.

Commands	Descriptions
show vlan brief	Display a list of all VLANs

The following is an example displaying a list of VLAN on system.

```
DUT-1#show vlan brief
Bridge VlanID Name           State    Member-ports([u]-Untagged,[t]-Tagged)
 ------ ------ --------------- --------- -------------------------------------
 1      1      default         active    [u]fe1.2 [u]fe1.3 [u]fe1.4 [u]fe1.5
                                         [u]fe1.6 [u]fe1.7 [u]fe1.8 [u]fe2.2
                                         [u]fe2.3 [u]fe2.4 [u]fe2.5 [u]fe2.6
```

```
                                        [u]fe2.7 [u]fe2.8 [u]fe3.1 [u]fe3.2
                                        [u]fe3.3 [u]fe3.4 [u]fe3.5 [u]fe3.6
                                        [u]fe3.7 [u]fe3.8 [u]ge2 [u]fe1.1
                                        [t]fe2.1
 1     10    testVLAN        active    [u]ge1 [t]fe2.1
 1     100   VLAN0100        active    [t]fe2.1
DUT-1#
```

Chapter 8 Configuring STP

This chapter describes how to configure the Spanning Tree Protocol (STP) on your system.

This chapter consists of these sections:

- Understanding Spanning Tree Features
- VLAN Bridge STP
- Creating Bridge Group
- Configuring Spanning Tree Features
- Displaying the Spanning Tree Features

8.1 Understanding the Spanning Tree Features

These sections describe how spanning-tree features work:

- ✓ STP Overview
- ✓ Election of the Root Switch
- ✓ Creating the Spanning Tree Topology
- ✓ Spanning Tree Interface States

STP Overview

STP is a Layer 2 link management protocol that provides path redundancy while preventing loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two stations. Spanning-tree operation is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or a switched LAN of multiple segments.

When you create fault-tolerant internetworks, you must have a loop-free path between all nodes in a network. The spanning-tree algorithm calculates the best loop-free path throughout a switched Layer 2 network. Switches send and receive spanning-tree frames, called bridge protocol data units (BPDUs), at regular intervals. The switches do not forward these frames, but use the frames to construct a loop-free path.

Multiple active paths among end stations cause loops in the network. If a loop exists in the network, end stations might receive duplicate messages. Switches might also learn end-station MAC addresses on multiple Layer 2 interfaces. These conditions result in an unstable network.

Spanning Tree defines a tree with a root switch and a loop-free path from the root to all switches in the Layer 2 network. Spanning tree forces redundant data paths into a standby (blocked) state. If a network segment in the spanning tree fails and a redundant path exists, the spanning-tree algorithm recalculates the spanning-tree topology and activates the standby path.

When two interfaces on a switch are part of a loop, the spanning-tree port priority and path cost settings determine which interface is put in the forwarding state and which is put in the blocking state.

The port priority value represents the location of an interface in the network topology and how well it is located to pass traffic. The path cost value represents media speed.

Election of the Root Switch

All switches in the Layer 2 network participating in spanning tree gather information about other switches in the network through an exchange of BPDU data messages. This exchange of messages results in these actions:

- The election of a unique root switch for each spanning-tree instance
- The election of a designated switch for every switched LAN segment
- The removal of loops in the switched network by blocking Layer 2 interfaces connected to redundant links

For each VLAN, the switch with the highest switch priority (the lowest numerical priority value) is elected as the root switch. If all switches are configured with the default priority (32768), the switch with the lowest MAC address in the VLAN becomes the root switch. The switch priority value occupies the most significant bits of the bridge ID.

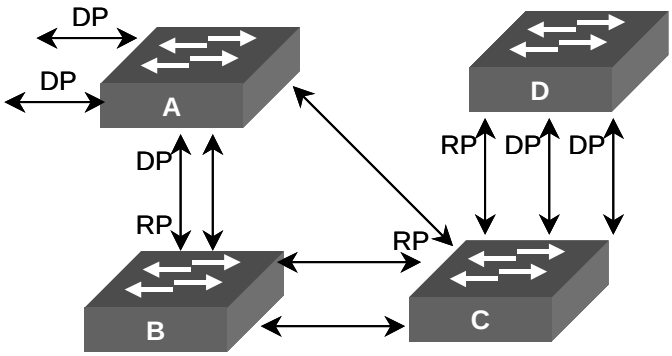
When you change the switch priority value, you change the probability that the switch will be elected as the root switch. Configuring a higher value decreases the probability; a lower value increases the probability.

The root switch is the logical center of the spanning-tree topology in a switched network. All paths that are not needed to reach the root switch from anywhere in the switched network are placed in the spanning-tree blocking mode.

BPDUs contain information about the sending switch and its ports, including switch and MAC address, switch priority, port priority, and path cost. Spanning tree uses this information to elect the root switch and root port for the switched network and the root port and designated port for each switched segment.

Creating the Spanning Tree Topology

In the below figure, Switch A is elected as the root switch because the switch priority of all the switches is set to the default (32768) and Switch A has the lowest MAC address. However, because of traffic patterns, number of forwarding interfaces, or link types, Switch A might not be the ideal root switch. By increasing the priority (lowering the numerical value) of the ideal switch so that it becomes the root switch, you force a spanning-tree recalculation to form a new topology with the ideal switch as the root



RP = Root Port

DP = Designated Port

[Spanning Tree Topology]

When the spanning-tree topology is calculated based on default parameters, the path between source and destination end stations in a switched network might not be ideal. For instance, connecting higher-speed links to an interface that has a higher number than the root port can cause a root-port change. The goal is to make the fastest link the root port.

For example, assume that one port on Switch B is a Gigabit Ethernet link and that another port on Switch B (a Fast Ethernet link) is the root port. Network traffic might be more efficient over the Gigabit Ethernet link. By changing the spanning-tree port priority on the Gigabit Ethernet interface to a higher priority (lower numerical value) than the root port, the Gigabit Ethernet interface becomes the new root port.

Spanning Tree Interface States

Propagation delays can occur when protocol information passes through a switched LAN. As a result, topology changes can take place at different times and at different places in a switched network. When an interface transitions directly from nonparticipation in the spanning tree topology to the forwarding state, it can create temporary data loops. Interfaces must wait for new topology information to propagate through the switched LAN before starting to forward frames. They must allow the frame lifetime to expire for forwarded frames that have used the old topology.

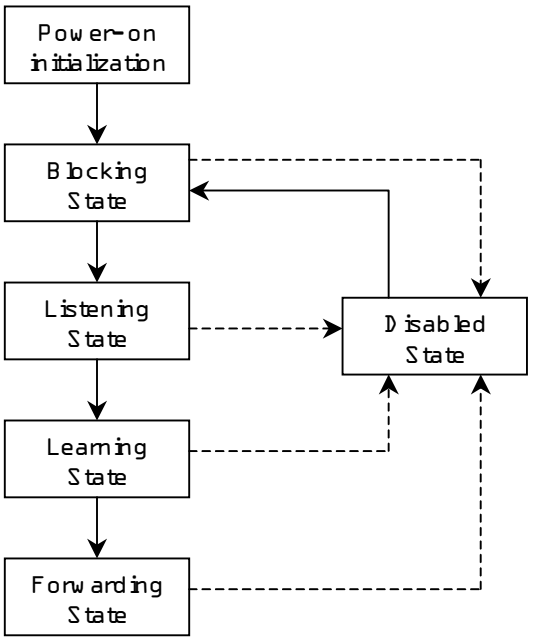
Each Layer 2 interface on a switch using spanning tree exists in one of these states

- ✓ Blocking – The interface does not participate in frame forwarding
- ✓ Listening – The first transitional state after the blocking state when the spanning tree determines that the interface should participate in frame forwarding
- ✓ Learning – The interface prepares to participate in frame forwarding
- ✓ Forwarding – The interface forwards frames
- ✓ Disabled – The interface is not participating in spanning tree because of a shutdown port, no link on the port, or no spanning-tree instance running on the port.

An interface moves through these states:

- ✓ From initialization to blocking
- ✓ From blocking to listening or to disabled
- ✓ From listening to learning or to disabled
- ✓ From learning to forwarding or to disabled
- ✓ Form Forwarding to disabled

The below figure illustrates how an interface moves through the states.



[Spanning Tree Interface States]

When you power up the system, STP is enabled by default, and every interface in the switch, VLAN or network goes through the blocking state and the transitory states of listening and learning. Spanning tree stabilizes each interface at the forwarding or blocking state.

When the spanning-tree algorithm places a Layer 2 interface in the forwarding state, this process occurs:

1. The interface is in the listening state while spanning tree waits for protocol information to transition the interface to the blocking state.

2. While spanning tree waits the forward-delay timer to expire, it moves the interface to the learning state and resets the forward-delay timer.

3. In the learning state, the interface continues to block frame forwarding as the switch learns end-station location information for the forwarding database.

4. When the forward-delay timer expires, spanning tree moves the interface to the forwarding state, where both learning and frame forwarding are enabled.

8.2 VLAN-Bridge STP

VX-MD3024's VLAN-bridge STP is used with the fallback bridging freature (bridge groups), which forwards non-IP protocols such as DECnet between two or more VLAN bridge domains or routed ports. The VLAN-bridge STP allows the bridge groups to form a spanning tree on top of the individual VLAN spanning trees to prevent loops from forming if there are multiple connections among VLANs. It also prevents the individual spanning trees from the VLANs being bridged from collapsing into a single spanning tree.

Fallback Bridging

With fallback bridging, the switch bridges together two or more VLANs or routed ports, essentially connecting multiple VLANs within one bridge domain. Fallback bridging forwards traffic that the switch does not route and forwards traffic belonging to a nonroutable protocol such as DECnet.

Fallback bridging does not allow the spanning trees from the VLANs being bridged to collapse; each VLAN has its own spanning-tree instance and a separate spanning tree, called the VLAN-bridge spanning tree, which runs on top of the bridge group to prevent loops.

A VLAN bridge domain is represented with switch virtual interface (SVI). A set of SVIs and routed ports (which do not have any VLANs associated with them) can be configured (grouped together) to form a bridge group. Recall that an SVI represents a VLAN of switch ports as one interface to the routing or bridging function in the system.

A bridge group is an internal organization of network interfaces on a system. Bridge groups can not be used to identify traffic switched within the bridge group outside the switch on which they are defined. Bridge groups on the same switch function as distinct bridges; that is, bridged traffic and bridge protocol data units (BPDUs) are not exchanged between different bridge groups on a system. An interface can be member of only one bridge group. Use a bridge group for each separately bridged (topologically distinct) network connected to the system.

8.3 Creating a Bridge Group

To configure fallback bridging for a set of SVIs or routed ports, these interfaces must be assigned to bridge groups. All interfaces in the same group belong to the same bridge domain. A maximum of 32 bridge groups can be configured on the system.

Beginning in Enable mode, follows these steps to create bridge group and assign an interface to it.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**bridge** *bridge-group* **protocol ieee vlan-bridge**	Assign a bridge group number, and specify the VLAN-bridge spanning tree protocol to run in the bridge group. For *bridge-group*, specify the bridge group number.The range is 1 to 32. Frames are bridged only among interfaces in the same group.
Step 3	**interface** *interface-id*	Enter interface configuration mode, and specify the interface on which you want to assign the bridge group
Step 4	**bridge-group** *bridge-group*	Assign the interface to the bridge group created in Step 2. By default, the interface is assigned to bridge group 1. An interface can be assigned to only one bridge group.
Step 5	**end**	Return to Enable mode.
Step 6	**show running-config**	Verify your entries.
Step 7	**write memory**	(Optional) Save your entries in the configuration file.

To remove a bridge group, use the **no bridge** *bridge-group* global configuration command. To remove an interface from a bridge group and to remove the bridge group, use the **no bridge-group** *bridge-group* interface configuration command.

This example shows how to create bridge group 10, to specify the VLAN-bridge STP to run in the bridge group. It assignes the interface fe1.1 to the bridge group and assigns to VLAN 100.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#bridge 10 protocol ieee vlan-bridge
```

```
DUT-1(config)#vlan database
DUT-1(config-vlan)#vlan 100 bridge 10
DUT-1(config-vlan)#exit
DUT-1(config)#interface fe1.1
DUT-1(config-if)#switchport
DUT-1(config-if)#bridge-group 10
DUT-1(config-if)#switchport mode access
DUT-1(config-if)#switchport access vlan 100
DUT-1(config-if)#end
DUT-1#
```

8.4 Configuring Spanning Tree Features

This section describes how to configure spanning-tree features:

- ✓ Configuring the Switch Priority
- ✓ Configuring the Port Priority
- ✓ Configuring the Path Cost
- ✓ Configuring the Hello Time
- ✓ Configuring the Forward-Delay Time
- ✓ Configuring the Maximum-Aging Time

Configuring the Switch Priority

You can globally configure the priority of an individual system when two switches tie for position as the root switch, or you can configure the likelihood that a switch will be selected as the root switch. This priority is determined by default; however, you can change it.

Beginning in Enable mode, follow these steps to change the switch priority.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode

Step 2	**bridge** *bridge-group* **priority** *number*	Change the priority of the system. For *bridge-grouop*, specify the bridge group number. The range is 1 to 32. For number, enter a number from 0 to 61440. The default is 32768. The lower the number, the more likely the system will be chosen as the root.
Step 3	**end**	Return to Enable mode.
Step 4	**show running-config**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entry in the configuration file.

This example shows how to set the switch priority to 4096 for bridge group 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#bridge 1 priority 4096
DUT-1(config)#
```

Configuring the Port Priority

If a loop occurs, spanning tree uses the port priority when selecting an interface to put into the forwarding state. You can assign higher priority values (lower numerical values) to interfaces that you want selected first and lower priority values (higher numerical values) that you want selected last. If all interfaces have the same priority value, spanning tree puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

Beginning in Enable mode, follow these steps to configure the port priority of an interface.

	Command	**Descriptioin**
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *interface-id*	Enter interface configuration mode, and specify the interface to set the priority.
Step 3	**bridge-group** *bridge-group* **priority** *number*	Change the priority of an interface For *bridge-group*, specify the bridge group number. The

		range is 1 to 32. For *number*, enter a number from 0 to 255. The lower number, the more likely that the interface on the system will be chosen as the root. The default is 128.
Step 4	**end**	Return to Enable mode.
Step 5	**show running-config**	Verify your entry.
Step 6	**write memory**	(Optional) Save your entry in the configuration file.

This example shows how to change the priority of the interface fe1.1 to 32 in bridge group 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#bridge-group 1 priority 32
DUT-1(config-if)#end
DUT-1#
```

Configuring the Path Cost

The spanning tree path cost default value is derived from the media speed of an interface. If a loop occurs, spanning tree uses cost when selecting an interface to put in the forwarding sate. You can assign lower cost values to interfaces that you want selected first and higher cost values that you want selected last. If all interfaces have the same cost value, spanning tree puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

By convention, the path cost is 1000/data rate of the attached LAN, in Mbps.

Beginning in Enable Mode, follow these steps to assign a path cost.

	Command	**Description**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Enter interface configuration mode, and specify theinterface to seet the path cost.

Step 3	**bridge-group** *bridge-group* **path-cost** *cost*	Assign the path cost of an interface. For *bridge-group,* specify the bridge group number. The range is 1 to 32. For *cost*, enter a number from 1 to 200,000,000. The higher the value, the higher cost.
Step 4	**end**	Return to Enable mode.
Step 5	**show running-config**	Verify your entry.
Step 6	**write memory**	(Optional) Save your entry in the configuration file.

Below table shows the path cost value according to link speed

Link Speed	Default Value	Available Range	Reference
4 Mbps	250	100 - 1000	IEEE
10 Mbps	100	50 – 600	IEEE
100 Mbps	19	10 - 60	IEEE
1 Gbps	4	3 - 10	IEEE
10 Gbps	2	1 - 5	IEEE

To return to the default path cost, use the **no bridge-group** *bridge-group* **path-cost** interface configuration command.

This example shows how to change the path cost on the interface fe1.1 in bridge group 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#bridge-group 1 path-cost 20
DUT-1(config-if)#end
DUT-1#write memory
[OK]
DUT-1#
```

Configuring Hello Time

You can configure the interval between the generation of configuration messages by the root switch by changing the hello time.

Beginning in Enable mode, follow these steps to configure the hello time.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**bridge** *bridge-group* **hello-time** *seconds*	Specify the interval between hello BPDUs. For *bridge-group*, specify the bridge group number. The range is 1 to 32. For *seconds*, enter a number from 1 to 10. The default is 2 seconds.
Step 3	**end**	Return to Enable mode.
Step 4	**show running-config**	Verify your entry.
Step 5	**write memory**	(Optional) Save your entry in the configuration file.

To return to the default setting, use the **no bridge** *bridge-group* **hello-time** global configuration command.

This example shows how to change the hello interval to 5 seconds in bridge group 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#bridge 1 hello-time 5
DUT-1(config)#end
DUT-1#
```

Configuring the Forward-Delay Time

The Forward-delay interval is the amount of time spent listening for topology change information after an interface has been activated for switching and before forwarding actually begins.

Beginning in Enable mode, follow these steps to change the forward-delay intervals:

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**bridge** *bridge-group* **forward-time** *seconds*	Specify the interval between hello BPDUs. For *bridge-group*, specify the bridge group number. The range is 1 to 32. For *seconds*, enter a number from 4 to 30. The default is 15 seconds.
Step 3	**end**	Return to Enable mode.
Step 4	**show running-config**	Verify your entry.
Step 5	**write memory**	(Optional) Save your entry in the configuration file.

To return to the default setting, use the **no bridge** *bridge-group* **forward-time** global configuration command.

This example shows how to change the forward-delay interval to 20 seconds in bridge group1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#bridge 1 forward-time 20
DUT-1(config)#end
DUT-1#
```

Configuring the Maximum-Aging Time

If a system does not receive BPDUs from the root switch within a specified interval, it tries to restructure the spanning tree topology.

Beginning in Enable mode, follow these steps to change the maximum-age time.

	Command	Descriptioni
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**bridge** *bridge-group* **max-age** *seconds*	Specify the interval between hello BPDUs. For *bridge-group*, specify the bridge group number. The

		range is 1 to 32. For *seconds*, enter a number from 6 to 40. The default is 20 seconds.
Step 3	**end**	Return to Enable mode.
Step 4	**show running-config**	Verify your entry.
Step 5	**write memory**	(Optional) Save your entry in the configuration file.

To return to the default setting, use the **no bridge** *bridge-group* **max-age** global configuration command.

This example shows how to change the maximum-age time to 15 in bridge group 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#bridge 1 max-age 15
DUT-1(config)#end
DUT-1#
```

8.5 Displaying the Spanning Tree Features

To display the spanning tree status, use the below command in Enable mode.

Command	Description
show spanning-tree	Displays spanning tree information of every bridge group and interfaces.

This example shows how to display the spanning tree information of the system.

```
DUT-1#show spanning-tree
% 1: spanning tree disabled
% 1: root path cost 0 - priority 32768
% 1: forward-time 11 - hello-time 5 - max-age 20 - root port 0
% 1: root id 8000000edc005300
```

```
% 1: bridge id 8000000edc005300
% 1: hello timer 0 - tcn timer 0 - topo change timer 0
% 1: 0 topology changes - last topology change Thu Jan  1 00:00:00 1970
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 1 sec
%  ge2: port 28 - id 801c - path cost 20000000 - designated cost 0
%  ge2: designated port id 801c - state Forwarding - priority 128
%  ge2: designated root 8000000edc005300
%  ge2: designated bridge 8000000edc005300
%  ge2: forward-timer 0 - hold-timer 0 - msg age timer 0
%  ge2: forward-transitions 1
%  ge2: portfast disabled
%  ge2: portfast bpdu-guard  default  - Current portfast bpdu-guard off
%  ge2: portfast bpdu-filter default  - Current portfast bpdu-filter off
%  ge2: no root guard configured    - Current root guard off
(output truncated)
```

Chapter 9 Configuring DHCP

This chapter describes how to configure the Dynamic Host Configuration Protocol (DHCP).

This chapter consists of these sections.

- DHCP Server
- DHCP Relay Agent
- DHCP Snoop

9.1 DHCP Server

This section describes how to configure DHCP server that assigns IP address to the clients dynamically. You can configure the global characteristics and each subnet's feature of the DHCP server.

To configure the DHCP server feature, first configure IP addresses that the DHCP server would assign to requesting clients, and configure information to transmit to the clients. IP address configuration tasks are explained in the following sections.

- ✓ Creating DHCP subnet
- ✓ Configuring network address
- ✓ Configuring a DHCP address pool
- ✓ Configuring static IP address
- ✓ Configuring Port-entry to assign IP address per port
- ✓ Enabling/Disabling DHCP server
- ✓ Displaying Address Binding Information
- ✓ Configuring the number of allowed IP address per Hardware address

Configuration procedures for transmitting information to the clients are described in the following sections.

- ✓ Configuring default router
- ✓ Configuring IP lease time
- ✓ Configuring Log server
- ✓ Configuring Merit-dump
- ✓ Configuring Root-path
- ✓ Configuring NTP server
- ✓ Configuring maximum massage length
- ✓ Configuring DNS server
- ✓ Configuring Domain name

Global configuration procedures setting the all of the DHCP subnet are described in the following sections.

- ✓ Configuring the Number of Allowed IP Address per Port
- ✓ Enabling/Disabling DHCP Server Function on Each L3 Interface
- ✓ Configuring Validation of Assigned IP Address
- ✓ Configuring Validation of Assigning IP Address

Creating DHCP subnet

DHCP subnet is an object that is related with each network address. For example, in order to assign an IP address belonging to 192.168.31.0/24 to the clients, you must create a subnet first and configure the network address of the subnet. There is no limit of number of DHCP subnet on your system.

You can configure a DHCP subnet with a name that is a symbolic string (such as “test”). Configuring a DHCP subnet places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt – from which you can configure subnet parameters (for example, the network address and default router list).

Beginning in Enable mode, follow these steps to create DHCP subnet.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Assign the name of the DHCP subnet to create.

If you enter the subnet name that is already exist, you can configure features of the DHCP subnet on the DHCP subnet mode. And if you enter a new subnet name, a new subnet would be created and you can move to the DHCP subnet mode to configure features of the new DHCP subnet.

This example shows how to create a DHCP subnet and display it.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
subnet "test" is newly created
DUT-1(dhcp-config)#end
DUT-1#show ip dhcp
dhcp server disabled
```

```
dhcp subnet list: test
Number of ARP packets for IP Address confirmimg : NOT DOING
Denied interface:NONE
Lease Limits :
 NONE.
ping-check : disabled
arp-check  : disabled
DUT-1#
```

Note If you enter already existing DHCP subnet name, subnet “test” is newly created message shall not be show.

Configuring network address

The first thing to configure a DHCP subnet is assigning network address of the subnet. The available IP addresses that the DHCP server may assign to clients shall be included in the network address of the subnet.

Beginning in Enable mode, follow these steps to configure network address of DHCP subnet.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Enter DHCP subnet configuration mode and assign the name of the DHCP subnet.
Step 3	**network** *A.B.C.D/M*	Assign network address of the DHCP subnet.

This example shows how to configure the network address of DHCP subnet named test to 192.168.31.0/24.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#network 192.168.31.0/24
DUT-1(dhcp-config)#end
```

```
DUT-1#show ip dhcp subnet test
Subnet test(index = 1) :
  network: 192.168.31.0/24
  interface : not configured
  IP address Pool(s) :
   None.
  lease <days:hours:minutes:seconds> <1:0:0:0>
  no domain is defined
  no dns-servers
  no default-routers
  no ntp servers
  no log servers
  no DHCP Max Message Size
  no merit-dump
  no root-path
  port-entry Trusted Vendor ID : none
  one-lease-per-client is disabled
DUT-1#
```

Note You should configure the network address of a DHCP subnet after creating the DHCP subnet. With no configured network address, You cannot configure network address related configuration.

Configuring a DHCP Address Pool

You can configure DHCP address pool to assign to clients. The IP addresses including in this DHCP address pool are dynamically assigned to clients. You can find the Static IP address assigning method and per port IP address assigning method (Port-Entry function) in the following sections.

Beginning in Enable mode, follow these steps to configure DHCP address pool.

	Commands	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Enter DHCP subnet configuration mode and assign the name of the DHCP subnet.
Step 3	**pool** *pool-name* **ip** *A.B.C.D [A.B.C.D]*	Assign the name of the DHCP address pool and IP address range to assign to the clients. For *pool-name*, specify the DHCP address

		pool. For *A.B.C.D [A.B.C.D],* specify the range of IP addresses to assign to the clients. You can set only one IP address in this field.
Step 4	**pool** *pool-name* **subnet-mask** *A.B.C.D*	Set the subnet mask of a specified DHCP address pool. If you don't enter this command, the DHCP address pool use the network mask of the DHCP subnet. For *A.B.C.D,* specify the subnet mask.

You must configure the network address of a DHCP subnet before configuring DHCP address pool. And you can configure only the IP address range of the DHCP address pool included in network address range of the DHCP subnet.

For example, you can assign only the IP address range from192.168.31.0 to 192.168.31.255 to the DHCP address pool within the network of which network address is 192.168.31.0/24.

This example shows how to configure address 192.168.31.2 and the range between 192.168.31.10 and 192.168.31.99 to the DHCP address pool in the DHCP subnet named test.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#pool testpool ip 192.168.31.2
DUT-1(dhcp-config)#pool testpool ip 192.168.31.10 192.168.31.99
DUT-1(dhcp-config)#end
```

Configuring static IP address

An address binding is a mapping between the IP address and Media Access Control (MAC) address of a client. The IP address of a client can be assigned manually by an administrator or assigned automatically form a pool by a DHCP server.

Manual bindings are IP addresses that have been manually mapped to the MAC addresses of hosts that are found in the DHCP database. Manual bindings are stored in the configuration on the DHCP

server. Manual bindings are just special address pools. There is no limit on the number of manual bindings but you can only configure one manual binding per host pool.

Automatic bindings are IP addresses that have been automatically mapped to the MAC addresses of hosts that are found in the DHCP database. Automatic bindings are stored on a remote host called database agent. The bindings are saved as text records for easy maintenance.

To configure a manual binding, first create a DHCP address pool, then specify the IP address and hardware address of the client. The hardware address is the MAC address.

Beginning in Enable mode, follow these steps to configure manual bindings.

	Commands	**Description**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**static ip** *A.B.C.D* **mac** *XX:XX:XX:XX:XX:XX*	Specify manual binding information. For *A.B.C.D*, specify the IP address of the client. For *XX:XX:XX:XX:XX:XX*, specify a hardware address for the client.

This example shows how to configure manual binding that the static IP address is 192.168.31.5 and MAC address is 00:01:02:03:04:05 on the DHCP subnet named test.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#static ip 192.168.31.5 mac 00:01:02:03:04:05
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring Port-Entry to Assign IP Address per Port

You can configure the IP address to be assigned to the specific port with port entry function.

Beginning in Enable mode, follow these steps to configure port entry function.

	Commands	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**port-entry** *if-name A.B.C.D* **[***A.B.C.D***] [vendor-id** *vendor-id***]**	Specify the assigning IP address range to the specific interface. For *if-name*, specify the name of the L2 interface. For *A.B.C.D A.B.C.D*, specify the IP address range assigned to the interface. For *vendor-id*, specify the vendor identifier that is string type.

As you configure port entry function, the vendor ID item is optional. If you specify vendor ID of an interface, only the client that has vendor ID in the interface can be assigned the specified IP address in the port-entry configuration. If you don't specify vendor ID, the client connected in the interface can be assigned with the specified IP address in port-entry configuration.

This example shows how to configure port entry function that the range of IP address from 192.168.31.100 to 192.168.31 to be assigned to the clients those are connected to the physical port fe1.4.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#port-entry fe1.4 192.168.31.100 192.168.31.103
DUT-1(dhcp-config)#end
DUT-1#
```

The next example shows how to configure port entry function that IP address range between

192.168.31.104 and 192.168.31.105 to be assigned to the clients having vender ID “MSFT 5.0” and being connected to the physical port fe1.4.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#port-entry fe1.4 192.168.31.104 192.168.31.105 vendor-id
MSFT 5.0
DUT-1(dhcp-config)#end
```

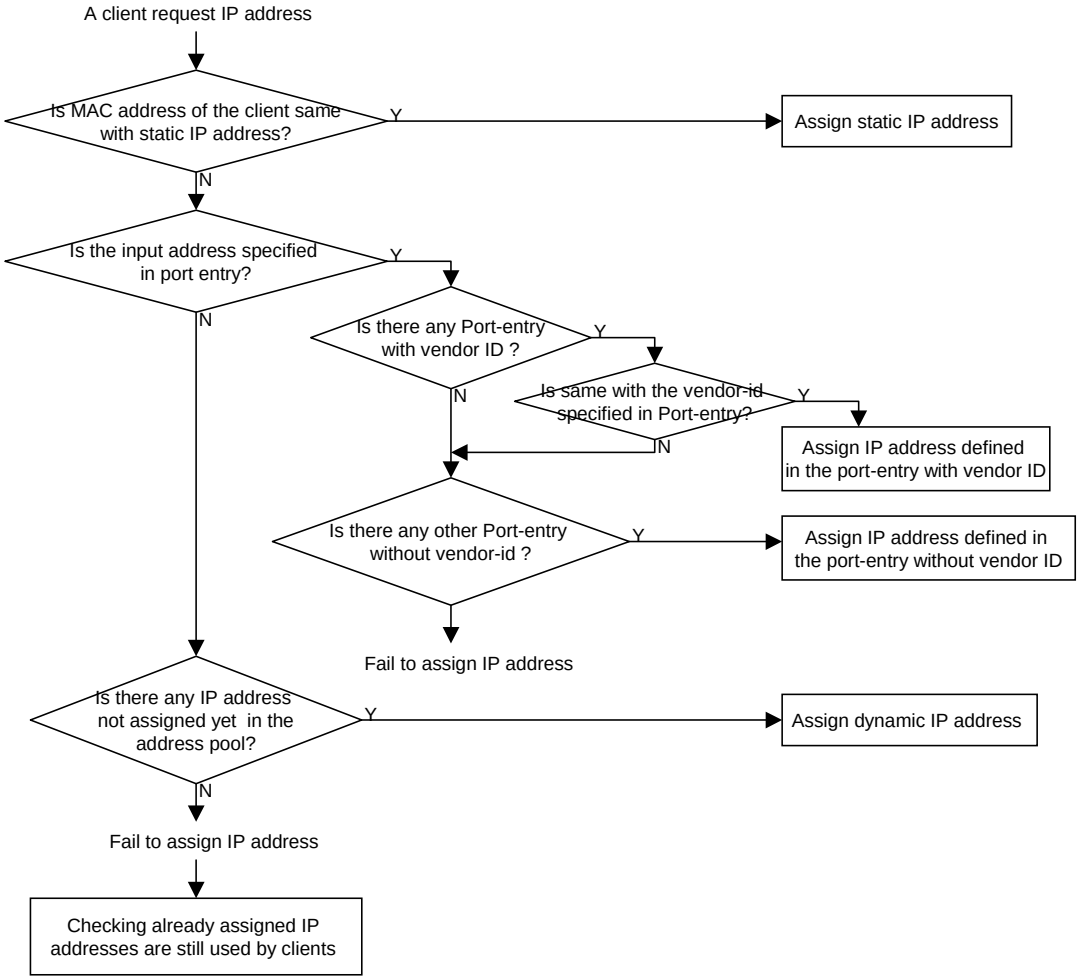
Rule of IP address Assigning

There are three types of IP address assigning method as of dynamic binding, manual binding and binding with port entry method.

Following figure shows steps how to find out proper IP addresses when the system received IP address request from the client.

If the DHCP server received IP address request from clients, it examine list of the static IP address first. It checks whether the static IP address is defined in the configuration and if static IP address is defined and the requesting client’s MAC address is same, then assign the static IP address to the client.

If the client’s MAC address is not configured with the static IP address in the DHCP server configuration, DHCP server checks that the interface which IP address request received from is defined in the port-entry configuration. There is two kind of type of port-entry configuration. One is defined with vendor ID, and the other is defined without vendor ID. If the port-entry is defined with vendor ID, the DHCP server only assign IP address defined in port-entry to the client when the vendor ID of the client is same with the vendor ID of the defined in the port-entry. If there is not port-entry which has the same vendor ID with the client’s vendor ID, DHCP server find the port-entry without vendor ID definition. If there is any port-entry without vendor ID definition for the interface that is connected to the client, it assigns the IP address defined in the port-entry to the client. But if there is not port-entry without vendor ID definition, the assigning IP address procedure is failed.


A client request IP address
Is MAC address of the client same with static IP address?
Y
Assign static IP address
N
Is the input address specified in port entry?
Y
N
Is there any Port-entry with vendor ID ?
Y
N
Is same with the vendor-id specified in Port-entry?
Y
N
Assign IP address defined in the port-entry with vendor ID
Is there any other Port-entry without vendor-id ?
Y
Assign IP address defined in the port-entry without vendor ID
Fail to assign IP address
Is there any IP address not assigned yet in the address pool?
Y
Assign dynamic IP address
N
Fail to assign IP address
Checking already assigned IP addresses are still used by clients

If the port-entry is not configured to the physical interface with which the client is connected, assign an IP address in the dynamic address pool to the client. If all of the IP addresses in the dynamic address pool are already allocated to the other clients, assigning IP address procedure is failed. And the DHCP server checks whether the IP address that is assigned but not used by client is exist or not. If you enable this checking function, the unused IP address will be assigned to the client which requests IP address in the next time.

Enabling/Disabling DHCP server

Beginning in Enable mode, follow these steps to activate DHCP server function.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service dhcp**	enable DHCP server

To deactivate DHCP server function, use **no service dhcp** command in global configuration mode.

This example shows how to enable DHCP server function and display the status of DHCP server.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#service dhcp
DUT-1(config)#end
DUT-1#show ip dhcp
dhcp server enabled
dhcp server running now
dhcp subnet list: test
Number of ARP packets for IP Address confirmimg : NOT DOING
Denied interface:NONE
Lease Limits :
 NONE.
ping-check : disabled
arp-check  : disabled
DUT-1#
```

Displaying Address Binding Information

You can display the information of address binding with the various conditions. Beginning in Enable mode, follow these steps to display the information of address binding.

	description
show ip dhcp bind-info [detail]	Display all information of address binding.

show ip dhcp bind-info ip *A.B.C.D* **[***A.B.C.D***] [detail]**	Display only the binding information which has the address included in the specified address range.
show ip dhcp bind-info subnet *subnet-name* **[detail]**	Display only the binding information of which address is assigned in the specified subnet.
show ip dhcp bind-info status { active | free | abandoned } [detail]	Display the IP addresses of which status is the specified status.
show ip dhcp bind-info type { dynamic | port-entry | static } [detail]	Display the binding information of which the address assigning method is same with the specified binding method.
show ip dhcp bind-info statistics	Display only the statistics of address binding.

This example shows how to display information of address binding of which IP address is included in the range from.168.31.95 and 192.168.31.105.

```
DUT-1#show ip dhcp bind-info ip 192.168.31.95 192.168.31.105
*********************************************************************
                    DHCP Server Binding Information
*********************************************************************
ACTIVE : total   1 | dynamic   1 | static   0 | port-entry   0
FREE   : total  10 | dynamic   4 | static   0 | port-entry   6
ABANDON: total   0 | dynamic   0 | static   0 | port-entry   0
---------------------------------------------------------------------
IP-Address     Type  Status MAC-Address      Expiration        phyIF
---------------------------------------------------------------------
192.168.31.95 Dynamic FREE  N/A               N/A               N/A
192.168.31.96 Dynamic FREE  N/A               N/A               N/A
192.168.31.97 Dynamic FREE  N/A               N/A               N/A
192.168.31.98 Dynamic FREE  N/A               N/A               N/A
192.168.31.99 DynamicACTIVE00:0e:dc:31:00:01 2005:11:01 17:11:13 N/A
192.168.31.100P-Entry FREE  N/A               N/A               N/A
192.168.31.101P-Entry FREE  N/A               N/A               N/A
192.168.31.102P-Entry FREE  N/A               N/A               N/A
192.168.31.103P-Entry FREE  N/A               N/A               N/A
192.168.31.104P-Entry FREE  N/A               N/A               N/A
192.168.31.105P-Entry FREE  N/A               N/A               N/A
---------------------------------------------------------------------
```

Configuring the number of allowed IP address per Hardware address

Basically, only one IP address shall be assigned to a client that has a MAC address. But sometimes, several IP addresses can be assigned to a client with a MAC address. To prevent a client with a MAC address be assigned several IP address from the DHCP server, you can configure that only one IP address is assigned to the client with single MAC address.

Beginning in Enable mode, follow these steps to configure only one IP address is assigned to the single MAC client.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**one-lease-per-client**	Configuring only one IP address is assigned to a MAC address.

Configuring Default Router

After DHCP client has booted, the client begins sending packets to its default router. The IP address of the default router should be on the same subnet as the client. Beginning in Enable mode, follow these steps to configure a default router for a DHCP client.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subne-tname*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**default-router** *A.B.C.D*	Specifies the IP address of the default router for a

	DHCP client.

This example shows how to configure the IP address of the default router for a DHCP client to192.168.31.254.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#default-router 192.168.31.254
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring IP lease time

By default, each IP address assigned by a DHCP server comes with a one-day lease, which is the amount of time that the address is valid. Beginning in Enable mode, follow these steps to change the lease value for an IP address.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**lease { <***day***> <***hour***> <***minute***> <***second***> | infinite }**	Specifies the duration of the lease. The default is a one-day lease.

This example shows how to configure IP address lease time to1 hour and 20 minutes.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#lease 0 1 20 0
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring Log Server

Log server is DHCP option 7. It specifies the IP address of SYSLOG server that the client should send error messages and other logging information. Beginning in Enable mode, follow these steps to configure a log server for a DHCP client.

	Comman	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**log-server** *A.B.C.D*	Specifies IP address of log server.

This example shows how to configure IP address of log server to 100.10.10.254 and 100.10.11.254.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#log-server 100.10.10.254
DUT-1(dhcp-config)#log-server 100.10.11.254
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring Merit-dump

Merit-dump is DHCP option 14. Merit-dump configuration specifies the path of the file dumped when it happens serious errors in client's system.

Beginning in Enable mode, follow these steps to configure a merit dump for a DHCP client.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**merit-dump** *merit-dump*	Specifies the path of the merit-dump

This example shows how to configure the path of merit-dump to "/etc/merit" to the client .

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#merit-dump /etc/merit
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring Root-path

Root-path configuring is DHCP option 17. It specifies the path name that contains the root disk of the client. The path is formatted as ASCII text. For this option type, data used for a value is ASCII character text.

Beginning in Enable mode, follow these steps to configure a root path for a DHCP client.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnet-name*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**root-path** *root-path*	Specifies the root path.

This example shows how to configure the root-path of a client to “/home/user”.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#root-path /home/user
DUT-1(dhcp-config)#end
DUT-1#show ip dhcp subnet test
Subnet test(index = 1) :
  network: 192.168.31.0/24
  interface : not configured
  IP address Pool(s) :
   Pool "testpool"
    Subnet Mask : 255.255.255.0
    IP Address Range(s):
     192.168.31.2
     192.168.31.10 ~ 192.168.31.99
  lease <days:hours:minutes:seconds> <0:1:20:0>
  no domain is defined
  no dns-servers
  default-router(s):  192.168.31.254
  static IP Assignment :
    192.168.31.5 <-> 00:01:02:03:04:05
  no ntp servers
  Log Server List : 100.10.10.254, 100.10.11.254,
  no DHCP Max Message Size
  merit-dump : /etc/merit
  root path  : /home/user
  port-entry Trusted Vendor ID : none
  port-entry for fe1.4
    Vendor-ID : MSFT 5.0
    IP Address :
      192.168.31.104 ~ 192.168.31.105
  port-entry for fe1.4
    Vendor-ID : NOT SPECIFIED
    IP Address :
      192.168.31.100 ~ 192.168.31.103
  one-lease-per-client is enabled
DUT-1#
```

Configuring NTP server

NTP server is DHCP option 42. It specifies the IP addresses in the order of preference for Network Time Protocol (NTP) servers available to the client.

Beginning in Enable mode, follow these steps to configure the IP address of NTP server for a DHCP client.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnetname*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**ntp-server** *A.B.C.D*	Specifies the IP address of NTP server.

This example shows how to configure IP address of NTP server to 132.11.23.55 and 132.11.23.56 to the client included in test subnet.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#ntp-server 132.11.23.55
DUT-1(dhcp-config)#ntp-server 132.11.23.56
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring Maximum length of DHCP massage

Maximum length of DHCP massage is DHCP option 57. This configuration specifies the maximum massage length of DHCP messages.

Beginning in Enable mode, follow these steps to configure the maximum length of DHCP message for a DHCP client.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnetname*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**max-message-size <***max-size***>**	Specifies the permitted massage length of DHCP packet.

This example shows how to configure maximum length of DHCP massage to 10000.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#max-message-size 10000
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring DNS server

DHCP clients query DNS servers when they need to correlate host names to IP addresses.

Beginning in Enable mode, follow these steps to configure the DNS servers that are available to a DHCP client.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnetname*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**dns-server** *A.B.C.D*	Specifies the IP address of a DNS server that is available to a DHCP client.

This example shows how to configure IP address of DNS server to 168.126.63.1 and 168.126.63.2 to the client in the DHCP subnet named test.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#dns-server 168.126.63.1
DUT-1(dhcp-config)#dns-server 168.126.63.2
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring Domain name

The domain name of a DHCP client places the client in the general grouping of networks that make up the domain.

Beginning in Enable mode, follow these steps to configure a domain name string for the client.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp subnet** *subnetname*	Creates a name for the DHCP subnet and places you in DHCP subnet configuration mode – identified by the (dhcp-config)# prompt.
Step 3	**domain-name <***domainname***>**	Specifies the domain name for the client.

This example shows how to configure the domain name of the client to versatek.com.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp subnet test
DUT-1(dhcp-config)#domain-name versatek.com
DUT-1(dhcp-config)#end
DUT-1#
```

Configuring the Number of Allowed IP Address per Port

You can configure the limitation of the allowed number of IP address per physical interface. By default, this function is disabled.

Beginning in Enable mode, follow these steps to configure the allowed number of IP address for the physical interface.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp lease-limit <***if-name***> <***max-ip***>**	Specifies the allowed number of IP address for the interface. For *if-name*, specifies the interface name. For *max-ip*, specifies the maximum allowed number of IP address.

This example shows how to configure maximum allowed number of IP address for the physical port fe1.1 to 40.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp lease-limit fe1.1 40
DUT-1(config)#end
DUT-1#show ip dhcp
dhcp server enabled
dhcp server running now
dhcp subnet list: test
Number of ARP packets for IP Address confirmimg : NOT DOING
Denied interface:NONE
Lease Limits :
 physical interface fe1.1 limited maximum 40 IP(s)
ping-check : disabled
arp-check  : disabled
DUT-1#
```

Enabling/Disabling DHCP Server Function on Each L3 Interface

Basically, DHCP server configuring is enable to every L3 interface. But you can disable the DHCP server function of specified L3 interface.

Beginning in Enable mode, follow these steps to disable DHCP server function of a L3 interface.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp deny-interface <***if-name***>**	Disable a specified L3 interface's DHCP function. For *if-name*, specify the VLAN interface name.

This example shows how to configure "eth0" of L3 interface to be out of DHCP server function and display it.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp deny-interface eth0
DUT-1(config)#end
DUT-1#show ip dhcp
dhcp server enabled
dhcp server running now
dhcp subnet list: test
Number of ARP packets for IP Address confirmimg : NOT DOING
Denied interface: eth0
Lease Limits :
 physical interface fe1.1 limited maximum 40 IP(s)
ping-check : disabled
arp-check  : disabled
DUT-1#
```

Configuring Validation of assigned IP address

You can configure the DHCP server of your system to confirm the using IP address of clients when every IP addresses of dynamic IP address pool are already leased.

Beginning in Enable mode, follow these steps to configure the validation function of already assigned IP address usability.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp address-confirm-by-arp <***count***>**	Specified the number of ARP packets to validate the usability of IP address which is already assigned.

When dynamic IP pool is used out and a new request of IP address from new client, your system sends ARP request packets about already assigned IP address by every 1 second. If the ARP reply packet is not received, it shall be judged abnormal client and change the IP address's status to free. Thus this IP address can be assigned to the client that request an IP address next time.

This example shows how to configure the number of ARP packet used for confirming IP address to 5.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp address-confirm-by-arp 5
DUT-1(config)#end
DUT-1#show ip dhcp
dhcp server enabled
dhcp server running now
dhcp subnet list: test
Number of ARP packets for IP Address confirmimg : 5
Denied interface: eth0
Lease Limits :
 physical interface fe1.1 limited maximum 40 IP(s)
ping-check : disabled
arp-check  : disabled
DUT-1#
```

Configuring Validation of Assigning IP Address

When IP address shall be assigned to a client, there'll be a possibility for any other client to use the IP address illegally. If this IP address is assigned to a client, the client cannot be made a communication

by this collision IP address. To avoid this status, you can configure the confirming function that checks whether the IP address is in use by other client with ARP or ICMP ping packets. If you enable the IP address checking function with ARP packets, the DHCP server sends specified number of ARP packets to a pool address before assigning the address to a requesting client. If the ping is unanswered, the DHCP server assumes (with a high probability) that the address is not in use and assigns the address to the requesting client.

Beginning in Enable mode, follow these steps to enable and specify the number of ARP packets send to the pool address before assigning the address.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp arp-check <***count***>**	Specifies the number of ARP packets the DHCP server sends to a pool address before assigning the address to q requesting client.

To enable and specify the number of ICMP ping packets send to the pool address before assigning the address, use the following command beginning in Enable mode.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp ping-check <***count***>**	Specifies the number of ICMP ping packets the DHCP server sends to a pool address before assigning the address to q requesting client.

Both of ARP and ICMP ping cannot be used at the same time to check the using of IP address. And basically, these functions are disabled.

This example shows how to configure the number of ping packets the DHCP server should send to the pool address to 5, and display the result.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp ping-check 5
DUT-1(config)#end
```

```
DUT-1#show ip dhcp
dhcp server enabled
dhcp server running now
dhcp subnet list: test
Number of ARP packets for IP Address confirmimg : 5
Denied interface: eth0
Lease Limits :
 physical interface fe1.1 limited maximum 40 IP(s)
ping-check : enabled(request 5 times)
arp-check  : disabled
DUT-1#
```

9.2 DHCP Relay Agent

This section describes how to configure the DHCP relay agent to assign IP address to the DHCP clients. The DHCP Relay agent function relays the DHCP requests from clients to the DHCP server of the other network.

The DHCP relay agent can be summarized as follows.

- Configuring DHCP server IP address
- Activating DHCP Relay agent

Configuring DHCP server IP address

A DHCP relay agent is any device that forwards DHCP packets between clients and servers when they are not on the same physical subnet. Relay agent forwarding is distinct from the normal forwarding of an IP router, when IP datagrams are transparently switched between networks. By contrast, relay agents receive DHCP messages and the generate a new DHCP message to send on another interface.

If the DHCP server and the DHCP clients are on different networks or subnets, you must configure the switch with the **ip dhcp-relay** *A.B.C.D* command in global configuration mode. The general rule is to configure the command on Layer 3 interface closest to the client. The address used in the **ip dhcp-realy** *A.B.C,D* command can be a specific DHCP server IP address, or it can be the network address if other DHCP servers on the destination network segment. Using the network address enables any DHCP server to respond to requests.

Beginning in Enable mode, follow these steps to specify the packet forwarding address.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**ip dhcp-relay** *A.B.C.D*	Specify the DHCP packet forwarding address. If you have multiple servers, you can configure one IP address for each DHCP server. For A.B.C.D, specify a specific DHCP server

	address

To remove the DHCP packet forwarding address, use the no **ip dhcp-relay** *A.B.C.D* global configuration command.

This example shows how to configure the IP address of DHCP to 10.10.10.254, 10.10.20.254, and 10.10.30.254.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-relay 10.10.10.254
DUT-1(config)#ip dhcp-relay 10.10.20.254
DUT-1(config)#ip dhcp-relay 10.10.30.254
DUT-1(config)#end
DUT-1#show ip dhcp-relay
DHCP Relay Service : Disabled

DHCP Relay's Server List :
   DHCP Server #1 - 10.10.10.254
   DHCP Server #2 - 10.10.20.254
   DHCP Server #3 - 10.10.30.254
DHCP Option 82(Relay Agent Information Option) : Disabled
    - sub-option Circuit-ID : none
    - sub-option Remote-ID  : unknown
DUT-1#
```

Enabling DHCP Relay agent

Beginning in Enable mode, follow these steps to enable the DHCP relay agent.

	Command	Description
Step 1	**configure terminal**	Changing to Global configuring mode
Step 2	**service dhcp-relay**	Enable the DHCP relay agent on your system. By default, this feature is not enabled.

To disable the DHCP relay agent, use the **no service dhcp-relay** global configuration command.

This example shows how to enable the DHCP Relay agent.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#service dhcp-relay
DUT-1(config)#end
DUT-1#show ip dhcp-relay
DHCP Relay Service : Enabled

DHCP Relay's Server List :
   DHCP Server #1 - 10.10.10.254
   DHCP Server #2 - 10.10.20.254
   DHCP Server #3 - 10.10.30.254
DHCP Option 82(Relay Agent Information Option) : Disabled
    - sub-option Circuit-ID : none
    - sub-option Remote-ID  : unknown
DUT-1#
```

Note DHCP server function and DHCP Relay agent function can not be activated at the same time.

9.3 Configuring DHCP Snooping

This section describes how to configure DHCP snooping on your system.

Describing on concept of DHCP Snooping is as follows.

- ✓ Overview of DHCP snooping
- ✓ DHCP Snoop Lease Entry
- ✓ DHCP Snoop Mode

Configuring function of DHCP Snoop is as follows..

- ✓ Enabling DHCP Snooping Globally
- ✓ Enabling DHCP Snoop of a Physical Interface
- ✓ Configuring DHCP Snooping mode of a Physical Interface
- ✓ Configuring DHCP Snooping Initial Mode of a Physical Interface
- ✓ Configuring ARP Snooping of a Physical Interface
- ✓ Configuring Mode Transition Timer
- ✓ Configuring Mode Transition Trigger
- ✓ Displaying DHCP Snooping Lease Entry
- ✓ Adding Static DHCP Snoop Lease Entry
- ✓ Deleting DHCP Snoop Lease Entry

DHCP Snoop Lease entry

DHCP snooping is a DHCP security feature that provides network security by filtering using unassigned IP address by DHCP server and by building and maintaining a DHCP Snooping binding database (also referred to as a DHCP snoop lease entry).

The DHCP snooping lease entry contains the MAC address, the IP address, the remaining lease time, the binding type, and the physical interface. A DHCP lease entry shall be deleted automatically when the client release the IP address explicitly or expired lease time. And you can create a DHCP snooping lease entry by manual. The maximum number of lease entry per physical interface is 4 and this

number includes not only dynamic entry but also static least entry.

When the DHCP snooping mode turn into normal mode, only the clients registered in DHCP snooping lease entry can make a communication through your system. In the normal mode, your system permits only packets that have registered source IP address in the DHCP snooping lease entry and DHCP packets. And the ARP packet of which the sender IP address is the registered IP address and source MAC address is the registered MAC address shall be permitted. The other packets shall be discarded.

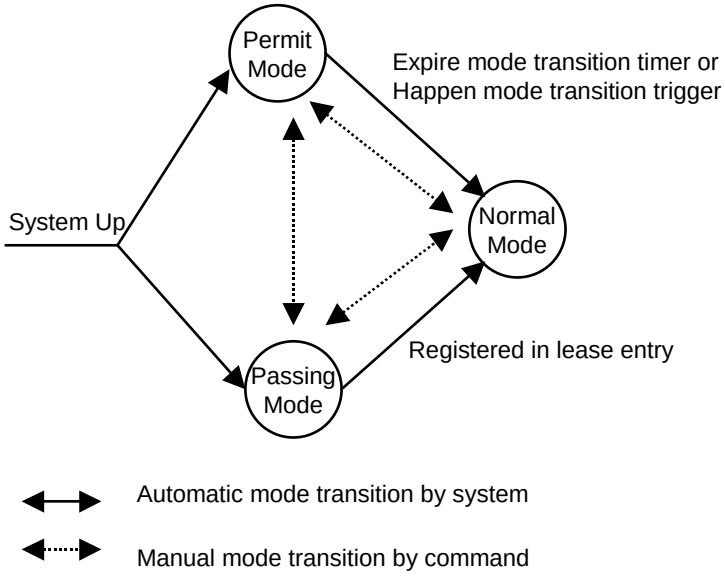
DHCP Snoop mode

DHCP snoop mode shall be normal mode, passing mode, and permit mode. You can configure the DHCP snoop mode per port basis. The following table summary the characteristics of the DHCP snooping mode.

DHCP Snoop mode	Description
Permit mode	If the DHCP snooping mode of a physical interface is permit mode, all kind of packets received from this interface are allowed. The DHCP snooping mode of the interface will be automatically moved to normal mode, when the mode transition timer expired or when the mode transition trigger happed. If you set the initial DHCP snoop mode of a physical interface, the DHCP snooping mode of the interface starts from permit mode after system initialization.
Passing mode	All of the packets received from the interface of which the DHCP snooping mode is passing mode are allowed. In this mode, the mode transition timer do not work. After at least one IP address is registered in the DHCP snooping lease entry, the DHCP snooping mode of the interface move to the normal mode automatically. You can configure this mode to be initial mode of a physical interface. In this case, the DHCP snooping mode of the interface starts from passing mode after system initialization.
Normal mode	Only the DHCP packets and the packets that has the source IP address and the hardware address registered in the DHCP snooping lease entry are allowed in this mode. The DHCP snooping mode is able to move to the other DHCP snooping mode by only user command. If you set the initial DHCP snooping mode

	of a physical interface to the normal mode, all of clients in the interface cannot make a communication after system initialization. Because the client keep on the IP address assigned before system reset, the IP address is not registered in the DHCP snoop lease entry. Thus you cannot configure this mode to be initial mode of an interface.

The following figure describes the DHCP snooping mode transition of a physical interface.



As above figure, each physical port's DHCP snooping mode is configured divided into current mode and initial mode. When the DHCP snooping function is enabled after initializing system, the DHCP snooping mode of each physical interface starts from permit mode or passing mode according to the initial DHCP snooping mode configured by you. The initial mode is the starting DHCP snooping mode of the physical interface, the first mode of the physical interface becomes the initial mode after rebooting system. The current mode is related with real working method of the DHCP snooping function. The current mode is able to transit to the other mode after the mode transition timer expire or after mode transition trigger happens.

After reboot your system, the physical interface of which the initial mode is configured to permitting mode start with permit mode. In this case all of packets received from the physical interface are allowed. After the mode transition timer is expired, the DHCP snooping mode is automatically moved to normal mode, and only packets those have allowed IP address will be allowed in the interface. And

after the mode transition trigger condition has happened, the DHCP snooping mode is changed to normal mode also. By default, the mode transition timer is 1800 seconds, and the mode transition trigger is 2.

After reboot your system, the physical interface of which initial mode is configured to passing mode do work as same as the interface of which initial mode is permitting mode. But the DHCP snooping mode of the physical interface would not change to the normal mode by expiring the transition timer. In this mode, the DHCP snooping mode only change to the normal mode after at least one lease entry is registered by the DHCP snooping function.

You can configure the initial mode of the physical interface to only the passing mode and permit mode. This limit is added to escape the blocking service problem that can be reached because the clients do not try to be reassigned IP address after rebooting system.

As above, the DHCP snooping mode automatically transit to the proper mode and you can configure the DHCP snooping mode. And you can configure that the DHCP snooping mode would not be changed automatically.

Enabling DHCP Snooping Globally

Beginning in Enable mode, follow these steps to enable the DHCP snooping globally.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**service dhcp-snoop**	Enable DHCP snooping globally.

To disable DHCP snooping globally, use the **no service dhcp-snoop** global configuration command.

This example shows how to enable DHCP snooping function globally.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#service dhcp-snoop
DUT-1(config)#end
```

Enabling DHCP Snoop of a Physical Interface

Beginning in Enable mode, follow these steps to enable the DHCP snooping on physical interface.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip dhcp-snoop <***if-name***>**	Enables DHCP snooping on a physical interface.

To disable DHCP snooping on a physical interface, use the **ip dhcp-snoop** *if-name* command on global configuration mode.

By default, the DHCP snooping status of the downstream link which are fe1.1 ~ fe3.8 is enable, and one of the upstream link which are ge1 and ge2 is disable. This example shows how to disable DHCP snoop function of fe1.3 and fe1.4 interface and display the result status.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no ip dhcp-snoop fe1.3
DUT-1(config)#no ip dhcp-snoop fe1.4
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode   TransTimer MaxLease Trg Trged ARPSnp
-------------------------------------------------------------------------
 fe1.1  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe1.2  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe1.3 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
 fe1.4 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
 fe1.5  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
(omitted)
 fe3.4  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.5  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.6  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.7  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.8  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
   ge1 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
   ge2 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
DUT-1#
```

Configuring DHCP Snooping mode of a Physical Interface

Beginning in Enable mode, follow these steps to configure the DHCP snooping mode of physical interface.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip dhcp-snoop <***if-name***> mode { normal | passing | permit } [manually]**	Configure the DHCP snooping mode to the specified mode. For *if-name*, specify the physical interface to configure DHCP snooping mode. For **{normal | passing | permit}**, specify the DHCP snooping mode to configure. For **manually**, specify this keyword for the DHCP snooping mode to stick to the specified mode after configuring the DHCP snooping mode. If you don't specify this keyword, the DHCP snooping mode automatically changed to the other mode by DHCP snooping mode transition condition.

When you configure the DHCP snooping mode of a physical interface to the passing mode or the permit mode, if you use the keyword **manually,** the DHCP snooping mode of the interface would not change to the normal mode in spite of expiring the mode transition timer or happening mode transition condition.

And if you configure the DHCP snooping mode with manually keyword, when the configuration could be stored in configuration file and the DHCP snooping mode will be in use in the next booting time.

Caution

If you configure the DHCP snooping mode to the normal mode with manually keyword, the packets received from that interface could be discard and make a big service problem. You must not configure the DHCP snooping mode of a interface to the normal mode with manually keyword.

This example shows how to configure the DHCP snooping mode of the physical interface fe1.1 to the

permit mode manually and to configure one of the physical interface fe1.2 to the passing mode without manually keyword.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-snoop fe1.1 mode permit manually
DUT-1(config)#ip dhcp-snoop fe1.2 mode passing
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode    TransTimer MaxLease Trg Trged ARPSnp
-------------------------------------------------------------------------
 fe1.1  ENABLE   Permit  Permit *   N/A / 1800    4    2    0    ON
 fe1.2  ENABLE   Permit  Passing    N/A / 1800    4    2    0    ON
 fe1.3 DISABLE   Permit  Permit     N/A / 1800    4    2    0    ON
 fe1.4 DISABLE   Permit  Permit     N/A / 1800    4    2    0    ON
 fe1.5  ENABLE   Permit  Normal     N/A / 1800    4    2    0    ON
(omitted)
 fe3.4  ENABLE   Permit  Normal     N/A / 1800    4    2    0    ON
 fe3.5  ENABLE   Permit  Normal     N/A / 1800    4    2    0    ON
 fe3.6  ENABLE   Permit  Normal     N/A / 1800    4    2    0    ON
 fe3.7  ENABLE   Permit  Normal     N/A / 1800    4    2    0    ON
 fe3.8  ENABLE   Permit  Normal     N/A / 1800    4    2    0    ON
   ge1 DISABLE   Permit  Permit     N/A / 1800    4    2    0    ON
   ge2 DISABLE   Permit  Permit     N/A / 1800    4    2    0    ON
DUT-1#
```

In the above example, the * mark means the DHCP snooping mode of the interface is configured manually and the DHCP snooping mode will not transit to other mode automatically.

Configuring DHCP Snooping Initial Mode of a Physical Interface

Beginning in Enable mode, follow these steps to configure the DHCP snooping initial mode of a physical interface.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip dhcp-snoop <***ifname***> init-mode { passing |**	Configure the DHCP snooping initial mode of a

permit }	physical interface to the specified mode. For *if-name*, specify the physical interface to configure DHCP snooping initial mode. For **{passing | permit}**, specify the DHCP snooping initial mode to configure.

This example shows how to the DHCP snooping initial mode of the physical interface fe1.1 and fe1.2 to the passing mode.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-snoop fe1.1 init-mode passing
DUT-1(config)#ip dhcp-snoop fe1.2 init-mode passing
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode   TransTimer MaxLease Trg Trged ARPSnp
--------------------------------------------------------------------------
 fe1.1  ENABLE   Passing Permit *   N/A / 1800    4    2   0    ON
 fe1.2  ENABLE   Passing Passing    N/A / 1800    4    2   0    ON
 fe1.3 DISABLE   Permit  Permit     N/A / 1800    4    2   0    ON
 fe1.4 DISABLE   Permit  Permit     N/A / 1800    4    2   0    ON
 fe1.5  ENABLE   Permit  Normal     N/A / 1800    4    2   0    ON
 fe1.6  ENABLE   Permit  Normal     N/A / 1800    4    2   0    ON
(omitted)
 fe3.6  ENABLE   Permit  Normal     N/A / 1800    4    2   0    ON
 fe3.7  ENABLE   Permit  Normal     N/A / 1800    4    2   0    ON
 fe3.8  ENABLE   Permit  Normal     N/A / 1800    4    2   0    ON
   ge1 DISABLE   Permit  Permit     N/A / 1800    4    2   0    ON
   ge2 DISABLE   Permit  Permit     N/A / 1800    4    2   0    ON
DUT-1#
```

Note When you configure the DHCP snooping initial mode of a physical interface, the current DHCP snooping mode of the interface have not effect on the configuration.

Configuring ARP Snooping of a Physical Interface

Beginning in Enable mode, follow these steps to enable ARP snooping function of a physical interface.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip arp-snoop <***if-name***>**	Enable the ARP snooping function of the specified physical interface. For *if-name*, specify the physical interface to enable ARP snooping function.

To disable ARP snooping function of a physical interface, use the **no ip arp-snoop** *if-name* command in global configuration mode.

This example shows how to disable the ARP snooping function of the physical interface fe1.1 and fe1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#no ip arp-snoop fe1.1
DUT-1(config)#no ip arp-snoop fe1.2
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode   TransTimer MaxLease Trg Trged ARPSnp
-------------------------------------------------------------------------
 fe1.1  ENABLE   Passing Permit *   N/A / 1800    4    2   0   OFF
 fe1.2  ENABLE   Passing Passing   N/A / 1800    4    2   0   OFF
 fe1.3 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
 fe1.4 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
 fe1.5  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
(omitted)
 fe3.5  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.6  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.7  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
 fe3.8  ENABLE   Permit  Normal    N/A / 1800    4    2   0    ON
   ge1 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
   ge2 DISABLE   Permit  Permit    N/A / 1800    4    2   0    ON
```

```
DUT-1#
```

Configuring Mode Transition Timer

When the DHCP snooping mode of a physical interface is the permit mode, the mode transition timer is used for the DHCP snooping mode to remain in the permit mode during specified duration. By default, the mode transition timer is 1800 seconds. If you change the value of the mode transition timer, the timer will restart. If the DHCP snooping mode of a physical interface is not the permit mode, just the value of the timer would be changed and the timer would not work.

Beginning in Enable mode, follow these steps to configure the value of mode transition timer.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip dhcp-snoop <***if-name***> mode-transition-timer <***timeout***>**	Set the mode transition timer of the specified physical interface. For *if-name*, specify the physical interface to configure the mode transition timer. For *timeout*, specify the timeout value.

This example shows how to configure the mode transition timer of the physical interface fe2.4 of which the DHCP snooping mode is the permit mode.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-snoop fe2.4 mode-transition-timer 5000
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode    TransTimer MaxLease Trg Trged ARPSnp
--------------------------------------------------------------------------
 fe1.1  ENABLE   Passing Permit *   N/A / 1800    4    2    0    OFF
 fe1.2  ENABLE   Passing Passing    N/A / 1800    4    2    0    OFF
(omitted)
 fe2.3  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
```

```
 fe2.4  ENABLE   Permit  Normal    N/A / 5000    4    2    0    ON
 fe2.5  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.6  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.7  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.8  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
(omitted)
 fe3.6  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe3.7  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe3.8  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
   ge1 DISABLE   Permit  Permit    N/A / 1800    4    2    0    ON
   ge2 DISABLE   Permit  Permit    N/A / 1800    4    2    0    ON
DUT-1#
```

This example shows how to configure the mode transition timer of the physical interface fe2.1 of which the current DHCP snooping mode is the normal mode to 1000 seconds.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-snoop fe2.1 mode-transition-timer 1000
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode    TransTimer MaxLease Trg Trged ARPSnp
--------------------------------------------------------------------------
 fe1.1  ENABLE   Passing Permit *   N/A / 1800    4    2    0    OFF
 fe1.2  ENABLE   Passing Passing    N/A / 1800    4    2    0    OFF
 fe1.3 DISABLE   Permit  Permit     N/A / 1800    4    2    0     ON
 fe1.4 DISABLE   Permit  Permit     N/A / 1800    4    2    0     ON
(omitted)
 fe2.1  ENABLE   Permit  Normal    N/A / 1000    4    2    0    ON
 fe2.2  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.3  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.4  ENABLE   Permit  Normal    N/A / 5000    4    2    0    ON
 fe2.5  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
(omitted)
 fe3.7  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe3.8  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
   ge1 DISABLE   Permit  Permit    N/A / 1800    4    2    0    ON
   ge2 DISABLE   Permit  Permit    N/A / 1800    4    2    0    ON
DUT-1#
```

Configuring Mode Transition Trigger

When the current DHCP snooping mode of a physical interface is the permit mode, the mode transition trigger is used for the DHCP snooping mode of the interface to be changed to the normal mode after the specified DHCP lease entry is registered in the DHCP snooping lease entry table. The mode transition trigger condition would work when the current DHCP snooping mode of the physical interface is only the permit mode.

Beginning in Enable mode, follow these steps to configure the mode transition trigger condition of a physical interface.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip dhcp-snoop <***ifname***> mode-transition-trigger <***trigger***>**	Set the mode transition trigger condition of the specified physical interface. For *if-name*, specify the physical interface to configure the mode transition trigger condition. For *trigger*, specify the count of the mode transition trigger condition.

This example shows how to configure the mode transition trigger of the physical interface fe2.3 to 4.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-snoop fe2.3 mode-transition-trigger 4
DUT-1(config)#end
DUT-1#show ip dhcp-snoop
DHCP Snooping Service : Enabled
 Port   Status  InitMode CurMode    TransTimer MaxLease Trg Trged ARPSnp
--------------------------------------------------------------------------
(omitted)
 fe2.1  ENABLE   Permit  Normal    N/A / 1000    4    2    0    ON
 fe2.2  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.3  ENABLE   Permit  Normal    N/A / 1800    4    4    0    ON
```

```
 fe2.4  ENABLE   Permit  Normal    N/A / 5000    4    2    0    ON
 fe2.5  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
 fe2.6  ENABLE   Permit  Normal    N/A / 1800    4    2    0    ON
(omitted)
   ge1 DISABLE   Permit  Permit    N/A / 1800    4    2    0    ON
   ge2 DISABLE   Permit  Permit    N/A / 1800    4    2    0    ON
DUT-1#
```

Displaying DHCP Snooping Lease Entry

This example shows how to display the DHCP snooping lease entry.

```
DUT-1#show ip dhcp-snoop lease-entry
IP Address        MAC Address    Mode    Port    ExpLeft   Filter
-------------------------------------------------------------------
192.168.31.99  00:0E:DC:31:01:02 DYNAMIC fe2.1    81103     YES
DUT-1#
```

The above example shows that client of which hardware address is 00:0E:DC:31:01:02 is assigned the IP address 192.168.31.99 and the IP address would be expired after 81103 seconds in the physical interface fe2.1. The last column means that the filter that is composed of the source IP address and the source hardware address in the DHCP snooping lease entry work normally. In other words, the packets of which the source IP address and the source hardware address are not match with the addresses in the DHCP snooping lease entry would be discard. If the value of this field is ‘NO’, the current DHCP snooping mode of the physical interface is not normal mode, and all of the packets from the interface would be allowed.

Adding Static DHCP Snoop Lease Entry

You can add a static DHCP snooping lease entry to a physical interface. If you add a static DHCP snooping lease entry, it will remain in the existence after rebooting your system and it will not expire the expiration timer because the static DHCP lease entry’s expiration timer do not work.

Beginning in Enable mode, follow these steps to add a static DHCP snooping lease entry.

	Command	Description
Step 1	**configure terminal**	Changing to global configuring mode
Step 2	**ip dhcp-snoop <***if-name***> static-lease-entry** *A.B.C.D* **[***XX:XX:XX:XX:XX:XX***]**	Add the specified static DHCP snooping lease entry to a physical interface. For *if-name*, specify the physical interface to add the new static DHCP snooping lease entry. For *A.B.C.D*, specify the IP address of adding static DHCP snooping lease entry. For *XX:XX:XX:XX:XX:XX*, specify the hardware address of adding static DHCP snooping lease entry. This is the optional.

When you add the DHCP snooping lease entry, you may not the hardware address of the static DHCP snooping lease entry. It is the optional information. When you add a new static DHCP snooping lease entry to a physical interface, If you don't specify the hardware address of the static entry, the ARP snooping function of the interface would not work as though the ARP snooping of the interface is enable.

This example shows how to add the static DHCP snooping lease entry of which the IP address is 192.168.31.253 to the physical interface fe2.2. And it also shows how to add the static DHCP snooping lease entry of which the IP address is 192.168.31.252 and the hardware address is 00:0E:DC:31:01:99 to the physical interface fe2.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip dhcp-snoop fe2.2 static-lease-entry 192.168.31.253
DUT-1(config)#ip dhcp-snoop fe2.2 static-lease-entry 192.168.31.252
00:0E:DC:31:01:99
DUT-1(config)#end
DUT-1#show ip dhcp-snoop lease-entry
IP Address        MAC Address      Mode    Port    ExpLeft   Filter
-------------------------------------------------------------------
192.168.31.99  00:0E:DC:31:01:02 DYNAMIC  fe2.1    81023    YES
192.168.31.252  00:0E:DC:31:01:99 Static  fe2.2    N/A      YES
192.168.31.253  00:00:00:00:00:00 Static  fe2.2    N/A      YES
```

```
DUT-1#
```

Deleting DHCP Snoop Lease Entry

To remove the DHCP snooping lease entry of a physical interface, use the following command in the global configuration mode.

	Command	Description
Step 1	**clear ip dhcp-snoop lease-entry** ***<ifname>*** *A.B.C.D* **[***XX:XX:XX:XX:XX:XX***]**	Delete the specified DHCP snooping lease entry. For *if-name*, specify the physical interface to delete the DHCP snooping lease entry. For *A.B.C.D*, specify the IP address of deleting DHCP snooping lease entry. For *XX:XX:XX:XX:XX:XX*, specify the hardware address of deleting DHCP snooping lease entry. This is the optional.

This example shows how to delete the DHCP snooping lease entry of which IP address is 192.168.31.252 and the hardware address is 00:0E:DC:31:01:99 on the physical interface fe2.2.

```
DUT-1#clear ip dhcp-snoop lease-entry fe2.2 192.168.31.252
00:0E:DC:31:01:99
DUT-1#show ip dhcp-snoop lease-entry
IP Address       MAC Address    Mode    Port   ExpLeft   Filter
-------------------------------------------------------------------
192.168.31.99  00:0E:DC:31:01:02 DYNAMIC  fe2.1    80971    YES
192.168.31.253  00:00:00:00:00:00 Static  fe2.2    N/A     YES
DUT-1#
```

Chapter 10 Configuring L2 Multicast

The Chapter 10 describes how to use CLI commands to configure IGMP snooping and IGMP proxy features for multicast services on the Layer 2.

This chapter consists of these sections:

- Understanding IGMP Snooping
- Configuring IGMP Snooping
- Displaying IGMP Snooping configuration
- Displaying IGMP Snooping Group
- Displaying IGMP Packet statistics
- Understanding IGMP Snooping Proxy
- Configuring IGMP Snooping Proxy

10.1 Understanding IGMP Snooping

In general, the L2 switch, when multicast traffic is processed as unknown MAC address or broadcast frame, result in the flooding of multicast traffic to all ports in that VLAN. In order to manage effectively unnecessary resources of the switch built in the DSLAM VX-MD3024, the switch can use IGMP snooping for controlling multicast traffic.

IGMP snooping can be used to constrain the flooding of multicast traffic to all ports in that VLAN by configuring the built-in L2 interfaces so that multicast traffic is switched to only those interfaces associated with IP multicast devices.

IGMP snooping requires the built-in switch to snoop on the IGMP transmissions between the ports and the router and to keep track of multicast groups and member ports. When the switch receives an IGMP Report message from a port for a particular multicast group, the switch adds the port number to the forwarding table entry; when it receives an IGMP Leave Group message from a port, it removes the port from the table entry. It also periodically deletes entries if it does not receive IGMP membership reports from the multicast clients.

10.2 Configuring IGMP Snooping

IGMP snooping allows systems to examine IGMP packets and make forwarding decisions based on their content. To enable IGMP snooping on the system to discover external multicast routers, the Layer 3 interfaces on the routers in the VLAN must already have been for configured for multicast routing.

This section describes how to configure IGMP snooping.

- ✓ Enable IGMP Snooping
- ✓ Specify Multicast router port
- ✓ Configure IGMP Querier
- ✓ Configure Fast Leave
- ✓ Configure Timer

Enabling IGMP Snooping

You can globally enable or disable IGMP snooping. When globally enabled or disabled, it is also enabled or disabled in all existing VLAN interfaces. IGMP snooping can be enabled and disabled on a per-VLAN basis. When IGMP snooping is globally enabled or disabled, the system can execute IGMP snooping.

Global IGMP snooping overrides the VLAN IGMP snooping. If global snooping is disabled, you cannot enable VLAN snooping. If global snooping is enabled, you can enable or disable VLAN snooping.

Beginning in Enable mode, follow these steps to globally enable IGMP snooping.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping**	Globally enable IGMP snooping in all existing VLAN interfaces.
Step 3	**end**	Return to Enable mode

This example shows how to enable and verify globally IGMP snooping when all existing VLAN, VLAN 1 and VLAN 2, is on binding with Bridge 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping
DUT-1(config)#end
DUT-1#show ip igmp snooping
IGMP Snooping is globally enabled
IGMP Snooping Proxy is disabled
Bridge 1: VLAN 1
IGMP Snooping enabled
       IGMP Snooping Robustness-value is 2
       IGMP snooping query interval is 125000 ms
       IGMP snooping Startup query interval is 31250 ms
       IGMP snooping max query response time is 100 cs
       IGMP Snooping last member query interval is 1000 ms
       IGMP Snooping last member query count is 2
       IGMP snooping other querier timeout interval is 255000 ms
       IGMP snooping group membership interval is 260000 ms
       IGMP snooping v1 router present timeout is 400000 ms
       IGMP snooping interface fe1.1 version 2
       IGMP snooping interface fe1.2 version 2
       IGMP snooping interface fe1.3 version 2
       IGMP snooping interface fe1.4 version 2
(output truncated)
Bridge 1: VLAN 2
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 2
       IGMP snooping query interval is 125000 ms
(output truncated)

DUT-1#
```

Beginning in Enable mode, follow these steps to configure IGMP snooping on a VLAN interface, in beginning Enable mode.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode

Step 2	**ip igmp snooping vlan (default |** *<2-4094>***) bridge** *<1-32>*	Enable IGMP Snooping on the VLAN interface
Step 3	**end**	Return to Enable mode

This example shows how to enable and verify IGMP snooping on the VLAN interface.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping vlan default bridge 1
DUT-1(config)#ip igmp snooping vlan 2 bridge 1
DUT-1(config)#end
DUT-1#show ip igmp snooping vlan default bridge 1
IGMP Snooping is globally enabled
IGMP Snooping Proxy is disabled
Bridge 1: VLAN 1
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 2
       IGMP snooping query interval is 125000 ms
       IGMP snooping Startup query interval is 31250 ms
       IGMP snooping max query response time is 100 cs
       IGMP Snooping last member query interval is 1000 ms
       IGMP Snooping last member query count is 2
       IGMP snooping other querier timeout interval is 255000 ms
       IGMP snooping group membership interval is 260000 ms
       IGMP snooping v1 router present timeout is 400000 ms
       IGMP snooping interface fe1.1 version 2
       IGMP snooping interface fe1.2 version 2
       IGMP snooping interface fe1.3 version 2
       IGMP snooping interface fe1.4 version 2
(    )
DUT-1#
```

Note The VLAN1 on the Bridge is configured to default VLAN. Using the command to enable IGMP snooping on the VLAN interface, use default VLAN for VLAN1 on the Bridge.

Configuring Multicast Router Port

If the built-in switch connects with a multicast router on the VLAN IGMP snooping is enabled, IGMP Report and Leave messages must be forwarded to the multicast router on the VLAN. The port connected to the multicast router is named the multicast router port or mrouter port.

Multicast router port or mrouter port can be configured automatically or manually. The learn't mrouter is configured automatically when the system receives IGMP Query message. The configured mrouter is configured manually by using CLI.

Note | You can use only configured mrouter when you configure on IGMP snooping proxy mode, because of ignoring IGMP Query message on downstream ports.

Beginning in Enable mode, follow these steps to configure IGMP snooping Mrouter port.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping mrouter interface** *if-name*	Specify the Layer 2 interface to the IGMP Snooping mrouter
Step 3	**end**	Return to Enable mode
Step 4	**show ip igmp snooping mrouter**	Verify your entries.

This example shows how to specify the ge1 port on the VLAN1.1 to mrouter port and verify the mrouter ports on the system. In this example, you can show the learn't mrouter that is configured by receiving IGMP query message on the ge2 port of VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping mrouter interface ge1
DUT-1(config)#end
DUT-1#show ip igmp snooping mrouter
Bridge 1:
 VLAN: 1  Igmp Snooping Enabled
```

```
   Mrouter -> ge1 (Configured)
 VLAN: 2  Igmp Snooping Enabled
 VLAN: 3  Igmp Snooping Enabled
   Mrouter -> ge2 (Learn't)
DUT-1#
```

Configuring IGMP Querier

The IGMP querier transmits IGMP general query messages and IGMP group specific messages. It sends the IGMP general query message on the constant interval (IGMP query interval) and sends IGMP group specific query message when it removes multicast group by receiving IGMP leave message on that multicast group. When the IGMP querier receives IGMP query message from the multicast router in the VLAN, the IGMP querier function is disabled the constant period (other querier timer) on the VLAN. If the IGMP querier is disabled, it uses only the IGMP query message from the router's IGMP query messages. This is named querier selection function. Therefore there is only one IGMP querier on a VLAN.

Note | The querier selection function will be automatically disabled in the IGMP snooping proxy mode because it ignores all IGMP query messages from the ports those are not the mrouter port.

Beginning in Enable mode, follow these steps to configure IGMP snooping querier in the VLAN.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping querier vlan (default |** *<2-4094>***) bridge** *<1-32>*	Enable IGMP snooping querier in the VLAN
Step 3	**end**	Return to Enable mode.
Step 4	**show ip igmp snooping querier**	Verify that the IGMP snooping querier is enabled on the VLAN interface.

This example shows how to configure and verify IGMP snooping querier in the VLAN1.1 and VLAN1.3. The case of VLAN1.3 is an example enabling other querier on receiving IGMP query message from

the multicast router.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping querier vlan default bridge 1
DUT-1(config)#ip igmp snooping querier vlan 3 bridge 1
DUT-1(config)#end
DUT-1#show ip igmp snooping querier
Bridge 1 : VLAN 1
       IGMP Snooping querier is enabled
Bridge 1 : VLAN 2
       IGMP Snooping querier is disabled
Bridge 1 : VLAN 3
       IGMP Snooping other-querier enabled
DUT-1#
```

Configuring IGMP Snooping Fast-Leave

When the IGMP snooping receives IGMP leave message, it acts IGMP leave process after waiting for the constant interval (Last Member Query Interval * Last Member Query Count). If you want to process IGMP leave procedure without waiting the constant interval, you must configure IGMP snooping fast-leave.

The reason using IGMP snooping fast leave is to prevent a loss of bandwidth when the change of IGMP group occurs frequently (eg. Channel Zapping). When the downstream port is stacked in fast leave configuration and two or more hosts are joined in that port, IGMP leave of a host can result in multicast service disruption problem. For resolving this problem, VX-MD3024 manages per-port and per-host for each group.

You can configure IGMP snooping fast-leave in per-VLAN and per-port. The per-VLAN configuration is prior to per-port configuration.

To configure the IGMP snooping fast-leave, follow these steps in Enable mode.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode

Step 2	**Ip igmp snooping fast-leave vlan (default|<2-4094>) bridge <1-32>**	Enable IGMP Snooping Fast-Leave for the VLAN
Step 3	**interface fe1.1**	Change the Layer 2 interface mode
Step 4	**ip igmp snooping fast-leave**	Enable IGMP Snooping Fast-Leave for the Layer 2 interface
Step 5	**end**	Return to Enable mode
Step 6	**show ip igmp snooping fast-leave**	Display the configured IGMP Snooping Fast-Leave

This example shows how to configure the IGMP snooping fast-leave on VLAN1.1 and VLAN1.2 and release the IGMP snooping fast-leave for fe2.1 and fe2.2 on the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping fast-leave vlan default bridge 1
DUT-1(config)#ip igmp snooping fast-leave vlan 2 bridge 1
DUT-1(config)#interface fe2.1
DUT-1(config-if)#no ip igmp snooping fast-leave
DUT-1(config-if)#exit
DUT-1(config)#interface fe2.2
DUT-1(config-if)#no ip igmp snooping fast-leave
DUT-1(config-if)#end
DUT-1#show ip igmp snooping fast-leave
Bridge 1 : VLAN 1
       IGMP Snooping fast-leave is enabled
              fe1.1 enabled
              fe1.2 enabled
              fe1.3 enabled
              fe1.4 enabled
      (output truncated)
              ge1 enabled
Bridge 1 : VLAN 2
       IGMP Snooping fast-leave is enabled
              fe2.1 disabled
              fe2.2 disabled
              fe2.3 enabled
              fe2.4 enabled
              fe2.5 enabled
```

```
              fe2.6 enabled
      (output truncated)
DUT-1#
```

Configuring IGMP Snooping Timer

The IGMP snooping process uses the following parameters for setting the timer value.

- ✓ Last Member Query Interval
- ✓ Last Member Query Count
- ✓ Robustness Variable
- ✓ Query Interval
- ✓ Other Query Interval
- ✓ Max Response Timeout
- ✓ Unsolicited Report Interval

When the switch receives the IGMP leave message (not in fast-leave state), it removes a port from the IGMP snooping group. At that time, the IGMP snooping leave timeout value is determined by the last member query interval and the last member query count. This shows how to calculate the IGMP snooping leave timeout, and default and range of last member query interval and last member query count.

- – IGMP Snooping Leave Timeout = Last Member Query Interval * Last Member Query Count
- – Last Member Query Interval : default(1000msec), minimum(1000msec), maximum(25500msec)
- – Last Member Query Count : default(2), minimum(2), maximum(7)

Beginning in Enable mode, follow these steps how to configure the last member query interval value.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping last-member-query-interval** <*1000-25500*> **vlan (default|**<*2-4094*>**) bridge** <*1-32*>	Configure the Last Member Query Interval in the VLAN.
Step 3	**end**	Return to Enable mode

This example shows how to configure the last member query interval; 2000msec in the VLAN1.1 and 4000msec in the VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping last-member-query-interval 2000 vlan default
bridge 1
DUT-1(config)#ip igmp snooping last-member-query-interval 4000 vlan 3
bridge 1
DUT-1(config)#end
DUT-1#show ip igmp snooping last-member-query-interval
Bridge 1 : VLAN 1
       IGMP Snooping last-member-query-interval is 2000 ms
Bridge 1 : VLAN 2
       IGMP Snooping last-member-query-interval is 1000 ms
Bridge 1 : VLAN 3
       IGMP Snooping last-member-query-interval is 4000 ms
DUT-1#
```

Beginning in Enable mode, follow these steps how to configure the last member query count.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping last-member-query-count** <*2-7*> **vlan (default|**<*2-4094*>**) bridge** <*1-32*>	Configure the Last Member Query Count in the VLAN
Step 3	**end**	Return to Enable mode

This example shows how to configure the last member query count 4 in the VLAN1.1 and 5 in the

VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping last-member-query-count 4 vlan default
bridge 1
DUT-1(config)#ip igmp snooping last-member-query-count 5 vlan 3 bridge 1
DUT-1(config)#end
DUT-1#show ip igmp snooping last-member-query-count
Bridge 1 : VLAN 1
       IGMP Snooping last-member-query-count is 4
Bridge 1 : VLAN 2
       IGMP Snooping last-member-query-count is 2
Bridge 1 : VLAN 3
       IGMP Snooping last-member-query-count is 5
DUT-1#
```

The robustness variable in the IGMP snooping enable mode affects the startup query interval, other querier interval and group membership interval. The startup query interval means the switch sends the IGMP general query message on a quarter of query interval cycle when starting the IGMP querier of the VLAN, and the group membership interval means the effective time of the group when generating the IGMP snooping group.

This shows how to determine the startup query interval, other querier interval and group membership interval.

- Startup Query Interval = Query Interval / 4 , Robustness Variable Times
- Other Querier Interval = (Robustness Variable * Query Interval) + (Query Max-Response Timeout / 2)
- Group Membership Interval = (Robustness Variable * Query Interval) + Query Max-Response Timeout

Beginning in Enable mode, follow these steps how to configure the robustness variable.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping robustness-value** <*2-7*>	Configure Robustness Variable in the VLAN

	vlan (default|<*2-4094*>**) bridge** <*1-32*>	
Step 3	**end**	Return to Enable mode

This example shows the value of robustness variable as 3 in the VLAN1.1 and 4 in the VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping robustness-value 3 vlan default bridge 1
DUT-1(config)#ip igmp snooping robustness-value 4 vlan 3 bridge 1
DUT-1(config)#end
DUT-1#show ip igmp snooping
IGMP Snooping is globally enabled
IGMP Snooping Proxy is disabled
Bridge 1: VLAN 1
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 3
       IGMP Snooping querier enabled
       IGMP snooping query interval is 125000 ms
       IGMP snooping Startup query interval is 31250 ms
       IGMP snooping max query response time is 1000 cs
       IGMP Snooping last member query interval is 2000 ms
       IGMP Snooping last member query count is 4
       IGMP snooping other querier timeout interval is 380000 ms
       IGMP snooping group membership interval is 385000 ms
       IGMP snooping v1 router present timeout is 400000 ms
       IGMP snooping interface fe1.1 version 2
       IGMP snooping interface fe1.2 version 2
       IGMP snooping interface fe1.3 version 2
       IGMP snooping interface fe1.4 version 2
       (output truncated)
Bridge 1: VLAN 3
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 4
       IGMP Snooping other-querier enabled
       IGMP snooping query interval is 125000 ms
       IGMP snooping Startup query interval is 31250 ms
       IGMP snooping max query response time is 1000 cs
       IGMP Snooping last member query interval is 4000 ms
       IGMP Snooping last member query count is 5
       IGMP snooping other querier timeout interval is 505000 ms
```

```
        IGMP snooping group membership interval is 510000 ms
        IGMP snooping v1 router present timeout is 400000 ms
        (output truncated)
DUT-1#
```

The other querier interval means the time stopping the IGMP querier in the VLAN when receiving the IGMP general query from the multicast router. The other querier interval is affected by the robustness variable, query interval and query max-response timeout, and can be configured directly by setting the value.

This shows how to determine the other querier interval. The default, minimum and maximum values are as follows.

- Other Querier Interval = (Robustness Variable * Query Interval) + (Query Max-Response Timeout / 2), minimum(60000msec), maximum(300000msec)

Beginning in Enable mode, follow these steps how to configure the other querier interval.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping other-querier-interval** *<60000-300000>* **vlan (default|***<2-4094>***) bridge** *<1-32>*	Configure Other Querier Interval in the VLAN
Step 3	**end**	Return to Enable mode

This shows how to configure the other querier interval 120000msec in the VLAN1.1 and 150000msec in the VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping other-querier-interval 120000 vlan default
bridge 1
DUT-1(config)#ip igmp snooping other-querier-interval 150000 vlan 3 bridge
1
```

```
DUT-1(config)#end
DUT-1#show ip igmp snooping other-querier-interval
Bridge 1 : VLAN 1
       IGMP Snooping other-querier-interval is 120000 ms
Bridge 1 : VLAN 2
       IGMP Snooping other-querier-interval is 255000 ms
Bridge 1 : VLAN 3
       IGMP Snooping other-querier-interval is 150000 ms
DUT-1#
```

The query interval means the cycle sending the IGMP general query in the VLAN on which the querier is configured.

This shows the default, minimum and maximum values of query interval.

- Query Interval = default(125000msec), minimum(1000msec), maximum(180000000msec)

Beginning in Enable mode, follow these steps how to configure the query interval value.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping query-interval** <*1000-180000000*> **vlan (default|**<*2-4094*>**) bridge** <*1-32*>	Configure Query Interval value in the VLAN
Step 3	**end**	Return to Enable mode

This shows how to configure the query interval in the VLAN; 60000msec in the VLAN1.1 and 250000msex in the VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping query-interval 60000 vlan default bridge 1
DUT-1(config)#ip igmp snooping query-interval 250000 vlan 3 bridge 1
DUT-1(config)#end
DUT-1#
```

The query max response time means the effective time of the query sent by the querier. For that query, only IGMP report message sent in the query max response time which is used for index of the other querier timeout and group membership interval is effective.

This shows the default, minimum and maximum values of query max response time.

- Query Max Response Time = default(1000csec), minimum(100csec), maximum(24000csec)

Beginning Enable mode, follow these steps how to configure the query max response time value.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ip igmp snooping query-max-response-time** <*100-24000*> **vlan (default|**<*2-4094*>**) bridge** <*1-32*>	Configure Query Max Response Time in the VLAN.
Step 3	**end**	Return to Enable mode

This example shows how to the query max response time 100csec in the VLAN1.1 and 2000csec in the VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping max-response-time 100 vlan default bridge 1
DUT-1(config)#ip igmp snooping max-response-time 2000 vlan 3 bridge 1
DUT-1(config)#end
DUT-1#
```

10.3 Displaying IGMP Snooping Configuration

Beginning in Enable mode, follow these steps how to display the IGMP snooping configuration.

	Command	Description
Step 1	**show ip igmp snooping**	Display global information of IGMP Snooping
Step 2	**show ip igmp snooping mrouter**	Display Mrouter information of IGMP Snooping

This example shows how to display the IGMP snooping global information and IGMP snooping Mrouter information.

```
DUT-1#show ip igmp snooping
IGMP Snooping is globally enabled
IGMP Snooping Proxy is disabled
Bridge 1: VLAN 1
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 3
       IGMP Snooping other-querier enabled
       IGMP Snooping fast-leave is enabled
       IGMP snooping query interval is 60000 ms
       IGMP snooping Startup query interval is 15000 ms
       IGMP snooping max query response time is 100 cs
       IGMP Snooping last member query interval is 2000 ms
       IGMP Snooping last member query count is 4
       IGMP snooping other querier timeout interval is 120000 ms
       IGMP snooping group membership interval is 181000 ms
       IGMP snooping v1 router present timeout is 400000 ms
       IGMP snooping interface fe1.1 version 2
       IGMP snooping interface fe1.2 version 2
       IGMP snooping interface fe1.3 version 2
       IGMP snooping interface fe1.4 version 2
       IGMP snooping interface fe1.5 version 2
       IGMP snooping interface fe1.6 version 2
  (output truncated)

DUT-1#show ip igmp snooping mrouter
Bridge 1:
 VLAN: 1  Igmp Snooping Enabled
 VLAN: 2  Igmp Snooping Enabled
 VLAN: 3  Igmp Snooping Enabled
    Mrouter -> ge2 (Configured)
DUT-1#
```

10.4 Displaying IGMP Snooping Group

Beginning in Enable mode, follow this step for displaying the IGMP snooping group.

	Command	Description
Step 1	**show ip igmp snooping groups**	Display the IGMP Snooping group

This example shows how to display the IGMP snooping group.

```
DUT-1#show ip igmp snooping groups
Bridge 1 : VLAN 1
IGMP Snooping  Connected Group Membership
Group Address  Last Reporter   Expires   Interface
----------------------------------------------------------------
225.100.100.101 192.168.10.26  00:01:26  fe1.1
225.100.100.102 192.168.10.26  00:01:27  fe1.1
225.100.100.103 192.168.10.26  00:01:27  fe1.1
225.100.100.104 192.168.10.26  00:01:25  fe1.1
225.100.100.105 192.168.10.26  00:01:29  fe1.1
225.100.100.106 192.168.10.26  00:01:30  fe1.1
DUT-1#
```

10.5 Displaying IGMP Snooping Statistics

Beginning in Enable mode, follow this step for displaying the IGMP snooping statistics.

	Command	Description
Step 1	**show ip igmpV2 snooping statistics**	Display the statistics information of IGMP Snooping

This example shows how to display the IGMP snooping statistics.

```
DUT-1#show ip igmpV2 snooping statistics

IGMP-V2 Snooping Statistics: Bridge 1  VLAN default
  Total valid pkts rcvd : 0
  Total invalid pkts rcvd : 0
  Number of Reports rcvd : 0
  Number of Leaves rcvd : 0
  Number of Membership Queries rcvd : 0
  Number of Reports tx : 0
  Number of Leaves tx : 0
  Number of Group-Specific Queries tx : 0
  Number of General Queries tx : 28
(output truncated)

DUT-1#
```

10.6 Understanding IGMP Snooping Proxy

The purpose of the IGMP proxy is to manage effectively the IGMP group using a small set of IGMP messages. The IGMP proxy enables Mrouter port to acts the IGMP report process, not forward the IGMP query message to ports in the VLAN when the switch receives the IGMP query from Mrouter. This IGMP report names the IGMP proxy report. The switch sends the IGMP query message to hosts using its querier in that VLAN, and sends the IGMP report/leave message to Mrouter only when generating or removing new group.

VX-MD3024 uses the IGMP snooping proxy for reducing unnecessary IGMP related processes in upstream router. When using the IGMP proxy, the IP address must be assigned in the VLAN.

VX-MD3024 supports proxy report, report/leave suppression functions for the IGMP snooping proxy.

10.7 Configuring IGMP Snooping Proxy

The IGMP snooping proxy must be configured in global configuration mode. Beginning in Enable

mode, follow these steps for configuring the IGMP snooping proxy.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**ip igmp snooping proxy**	Configure IGMP Snooping Proxy

This example shows how to configure the IGMP snooping proxy.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp snooping proxy
DUT-1(config)#end
DUT-1#show ip igmp snooping
IGMP Snooping is globally enabled
IGMP Snooping Proxy is enabled
Bridge 1: VLAN 1
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 3
       IGMP Snooping querier enabled
       IGMP Snooping fast-leave is enabled
       IGMP snooping query interval is 60000 ms
       IGMP snooping Startup query interval is 15000 ms
       IGMP snooping max query response time is 100 cs
       IGMP Snooping last member query interval is 2000 ms
       IGMP Snooping last member query count is 4
       IGMP snooping other querier timeout interval is 120000 ms
       IGMP snooping group membership interval is 181000 ms
       IGMP snooping v1 router present timeout is 400000 ms
       IGMP snooping interface fe1.1 version 2
       IGMP snooping interface fe1.2 version 2
       IGMP snooping interface fe1.3 version 2
       IGMP snooping interface fe1.4 version 2
       IGMP snooping interface fe1.5 version 2
       IGMP snooping interface fe1.6 version 2
(output truncated)
Bridge 1: VLAN 2
       IGMP Snooping enabled
       IGMP Snooping Robustness-value is 2
(output truncated)
```

Chapter 11 Configuring IP Multicast Routing

This chapter describes how to configure IGMP, IGMP proxy and PIM-SM for the IP multicasting service. This chapter contains the following contents.

- Understanding IP Multicast Routing
- Characteristics of VX-MD3024 IP Multicast Routing
- Understanding IGMP
- Configuring IGMP
- Displaying IGMP Configuration
- Displaying IGMP Group
- Understanding IGMP Proxy
- Configuring IGMP Proxy

11.1 Understanding IP Multicast Routing

The IP multicasting is a protocol scheme for transmitting the multicast packets to a group configured by two or more hosts, not one IP host. The group of these hosts contains devices in local networks and private networks or outside local networks.

In configuring the IP multicast routing, the IGMP is used between hosts and router to track the multicast groups of which hosts are members. PIM (Protocol-Independent Multicast)-DM(Dense Mode), PIM-SM, DVMRP(Distant-Vector Multicast Routing Protocol) and MOSPF(Multicast Open Shortest Path First) protocols are used between routers for multicast routing.

11.2 Characteristics of VX-MD3024 IP Multicast Routing

VX-MD3024 supports the following IP multicast routing mode to service IP multicast;

- ✓ NMRP (Non-Multicast Routing Protocol) mode : This is used between hosts and routers based on the IGMP, while not use the multicast routing protocols between VX-MD3024 and upstream routers, but the IGMP proxy as a role of host. The number of interface for communicating with upstream routers is one, and the interface names Mrouter.

11.3 Understanding IGMP

To participate in IP multicasting, multicast hosts, routers and multiplayer switches must have IGMP operating. This protocol is the group membership protocol used by hosts to inform routers and multiplayer switches of the existence of members on their directly connected networks and to allow them to send and receive multicast datagrams.

Multicast routers and switches learn about group membership when a host joining a new group sends an IGMP message to the group address declaring its membership.

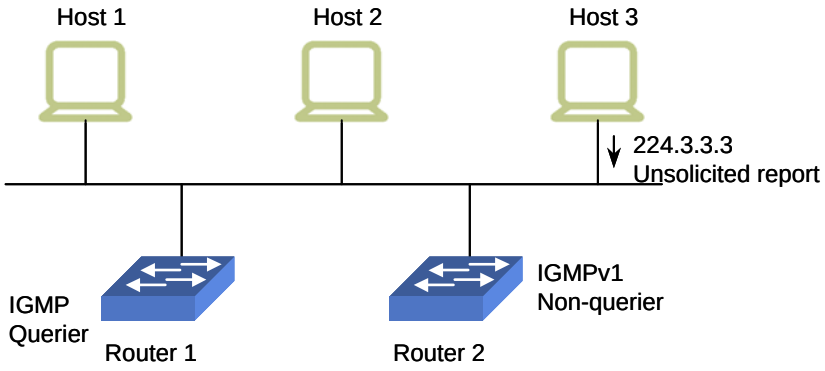
Using the information obtained through IGMP, routers and switches maintain a list of multicast group memberships on a per-interface basis. A multicast group membership is active on an interface if at least one host on that interface has sent an IGMP join message to receive the multicast group traffic.

IGMP Version 1

Most IP stacks in hosts today still use IGMPv1. This version primarily uses a query-response model that allows the multicast router and multilayer switch to determine which multicast groups are active (have one or more hosts interested in a multicast group) on the local subnet. In this model, the router or switch acting as the IGMP querier periodically (every 60 seconds) multicasts an IGMPv1 membership query to the all-hosts multicast group (224.0.0.1) on the local subnet. All hosts enabled for multicasting listen for this address and receive the query. A host responds with an IGMPv1 membership report to receive multicast traffic for a specific group, and routers or switches on the subnet learn where active receivers are for the multicast group.

A host can also join a multicast group by sending one or more unsolicited membership reports as shown in the following figure. In this example, Host 3 sends an unsolicited report to receive traffic for multicast group 224.3.3.3 instead of waiting for the next membership query from Router 1.

A host leaves a multicast group by ceasing to process traffic for the multicast group and to respond to IGMP queries.



[IGMPv1 Join Process]

IGMPv1 relies on the Layer 3 IP multicast routing protocols (PIM, DVMRP, and so forth) to resolve

which one of multicast routers or multilayer switches on a subnet should be the querier. The query router sends IGMPv1 queries to determine which multicast groups are active (have one or more hosts sending unsolicited reports) on the local subnet. In general, a designated router is selected as the querier.

IGMP Version 2

IGMPv2 provides enhancements over IGMPv1. The query and membership report messages are identical to IGMPv1 message with two exceptions. The first difference is that the IGMPv2 query message is broken into two categories: general queries, which perform the same function as the IGMPv1 queries, and group-specific queries, which are queries directed to a single group. The second difference is that different type codes are used with IGMPv1 and IGMPv2 membership reports. IGMPv2 also includes new features:

- ✓ Querier election process – IGMPv2 routers or multilayer switches can elect the query router without having to rely on the multicast routing protocol to perform this process.

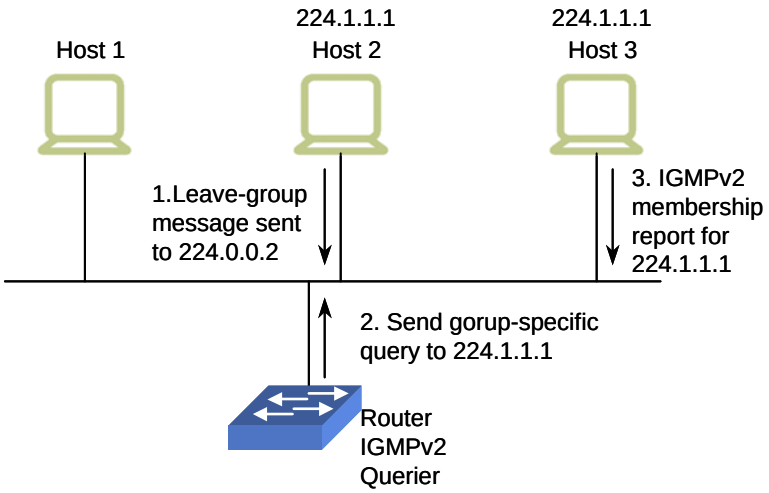
  As each IGMPv2 router or multilayer switch starts, it sends an IGMPv2 general query message to the all-host multicast group (224.0.0.1) with its interface address in the source IP address field of the message. Each IGMPv2 device compares the source IP address in the message with its own interface address, and the device with the lowest IP address on the subnet is elected as the querier.

- ✓ Maximum response time field – this field in the query message permits the query router to specify the maximum query-response time and controls the burstness of the response process.

  This feature can be important when large numbers of groups are active on a subnet and you want to spread the response over a longer period of time. However, increasing the maximum response timer value also increases the leave latency; the query router must now wait longer to make sure there are no more hosts for the group on the subnet.

- ✓ Group-specific query message – permits the query router to perform the query operation on a specific group instead of all groups.

- ✓ Leave group messages – provides hosts with a method of notifying routers and multilayer switches on the network that they are leaving a group as shown in the following figure.



[IGMPv2 Leave Process]

In this example, Hosts 2 and 3 are members of multicast group 224.1.1.1. Host 2 sends an IGMPv2 leave message to the all-multicast-routers group (224.0.0.2) to inform all routers and multilayer switches on the subnet that it is leaving the group. Router 1, the query router, receives the message, but because it keeps a list only of the group memberships that are active on a subnet and not individual hosts that are members, it sends a group-specific query to the target group (224.1.1.1) to determine whether any hosts remain for the group. Host 3 is still a member of multicast group 224.1.1.1 and receives the group-specific query, It responds with an IGMPv2 membership report to inform Router 1 that a member is still present. When Router 1 receives the report, it keeps the group active on the subnet. If no response is received, the query router stops forwarding its traffic to the subnet.

11.4 Configuring IGMP

As described in Chapter 12.2, IGMP supports NMRP mode or PIM-SM mode. This section describes how to support IP multicast routing to configure IGMP.

✓ Enabling or Disabling IGMP

- ✓ Configuring Multicast Router Port
- ✓ Configuring Fast Leave
- ✓ Configuring Time

Enabling or Disabling IGMP

IGMP is configured automatically when enabling NMRP mode or PIM-SM mode in the VLAN. Be careful that the command for IGMP configuration is divided according to modes.

Beginning in Enable mode, follow these steps to configure IGMP on NMRP mode.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**ip multicast-routing**	Enable IP multicast routing to NMRP mode
Step 3	**interface** *if-name*	Specify the Layer 3 interface on which you want to enable multicast routing, and enter interface configuration mode
Step 4	**ip multicast-routing**	Enable IP multicast routing to NMRP mode on the L3 interface

Note	IGMP interface must have IP address. Assign one or more IP address to the L3 interface to be configured to the IGMP interface.

This example shows how to enable and display IGMP configuration on NMRP mode when all VLANs, VLAN1.1, VLAN1.2 and VLAN1.3, are on binding with bridge 1.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip multicast-routing
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip multicast-routing
DUT-1(config-if)#exit
```

```
DUT-1(config)#interface vlan1.2
DUT-1(config-if)#ip multicast-routing
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.3
DUT-1(config-if)#ip multicast-routing
DUT-1(config-if)#exit
DUT-1(config)#end
DUT-1#show ip igmp interface
Interface vlan1.1
 IGMP Active, Querier, Default version 2
 Internet address is 1.1.1.254
 IGMP query interval is 125 seconds
 IGMP Startup query interval is 31 seconds
 IGMP querier timeout is 255 seconds
 IGMP max query response time is 10 seconds
 Last member query response interval is 1000 milliseconds
 Group Membership interval is 260 seconds
 Unsolicited Report interval is 10 seconds
 Robustness Variable is 2
(omitted)
DUT-1#
```

Configuring Multicast Router Port

VX-MD3024 system should send IGMP messages to upstream routers because of not performing IP multicast routing protocol in NMRP mode. You should configure the upstream layer 3 interface to be IGMP mrouter. There is able to be only one mrouter in VX-MD3024.

Beginning in Enable mode, follow these steps to configure IGMP mrouter port on NMRP mode.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the Layer 3 interface on which you want to enable IGMP mrouter, and enter interface configuration mode
Step 3	**ip igmp mrouter**	Enable IGMP mrouter

This example shows how to configure mrouter in the VLAN1.3 of all VLANs of the L3 interfaces, VLAN1.1, VLAN1.2 and VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.3
DUT-1(config-if)#ip igmp mrouter
DUT-1(config-if)#end
DUT-1#show ip igmp upstream-interface
IGMP Upstream-Interface
 Inteface vlan1.3.
DUT-1#show ip igmp downstream-interface
IGMP Downstream-Interfaces
 Interface vlan1.1
 Interface vlan1.2
DUT-1#
```

Configuring IGMP Fast-Leave

When IGMP enabled L3 interface receives IGMP leave message, it performs IGMP leave process after waiting constant time (Last Member Query Interval * Last Member Query Count). But if you configure IGMP snooping fast-leave, IGMP leave process make an advance directly without waiting the constant time.

IGMP fast-leave process prevents loss of bandwidth when change of IGMP group (ex. Channel Zapping) happens frequently. But when two or more hosts are joined in the same group in a port and a host from among the joined hosts sends leave message, multicast services of other hosts also can be stopped according to processing of IGMP leave message. To resolve this problem, VX-MD3024 manages each group for per-port and per-host.

Beginning in Enable mode, follow these steps to configure IGMP fast-leave.

Command	Description

Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface on which you want to configure the IGMP fast-leave and enter interface configuration mode
Step 3	**ip igmp fast-leave**	Configure IGMP fast-leave

This example shows how to configure IGMP fast-leave in the VLAN1.1 and VLAN1.3.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp fast-leave
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.3
DUT-1(config-if)#ip igmp fast-leave
DUT-1(config-if)#end
DUT-1#show ip igmp interface
Interface vlan1.1
 IGMP Enabled, Active, Querier, Configured for version 2
 Internet address is 1.1.1.254
 IGMP query interval is 125 seconds
 IGMP Startup query interval is 31 seconds
 IGMP querier timeout is 255 seconds
 IGMP max query response time is 10 seconds
 Last member query response interval is 1000 milliseconds
 IGMP fast-leave enabled
 Group Membership interval is 260 seconds
 Unsolicited Report interval is 10 seconds
 Robustness Variable is 2
(omitted)
DUT-1#
```

Configuring IGMP Timer

These show kind of variable to determine the value of timer used in IGMP process.

- ✓ Last Member Query Interval
- ✓ Last Member Query Count
- ✓ Robustness Variable
- ✓ Query Interval
- ✓ Other Query Interval
- ✓ Max Response Timeout
- ✓ Unsolicited Report Interval

When receiving IGMP leave message (not in fast leave state), the member is removed on IGMP group after waiting constant time. The IGMP leave timeout is determined by the last member query interval and the last member query count as below conditions;

- IGMP Snooping Leave Timeout = Last Member Query Interval * Last Member Query Count
- Last Member Query Interval : default(1000msec), minimum(1000msec), maximum(25500msec)
- Last Member Query Count : default(2), minimum(2), maximum(7)

Beginning in Enable mode, follow these steps to configure IGMP last member query interval.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface on which you want to configure IGMP last member query interface and enter interface configuration mode
Step 3	**ip igmp last-member-query-interval** *<1000-25500>*	Configure IGMP Last Member Query Interval

This example shows how to configure the last member query interval 2000msec in the VLAN1.1 and 4000msec in the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp last-member-query-interval 2000
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.2
DUT-1(config-if)#ip igmp last-member-query-interval 4000
DUT-1(config-if)#exit
DUT-1(config)#end
DUT-1#
```

Beginning in Enable mode, follow these steps to configure IGMP last member query counter.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface on which you want to configure IGMP last-member-query-count and enter interface configuration mode
Step 3	**ip igmp last-member-query-count** <*2-7*>	Configure IGMP last member query count

This example shows how to configure the last member query count 4 in the VLAN1.1 and 5 in the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp last-member-query-count 4
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.2
DUT-1(config-if)#ip igmp last-member-query-count 5
DUT-1(config-if)#end
```

The robustness variable affects startup query interval, other querier interval, group membership interval. The startup query interval is the interval between general queries sent by a querier on

startup. The default value of startup query interval is 1/4 general query interval., and other querier interval is the length of time that must pass before a multicast router decides that there is no longer another multicast router which should be the querier. This value must be ((the robustness variable) times (the query interval)) plus (one half of one query response interval). Group membership interval is the amount of time that must pass before a multicast router decides there are no more members of a group on a network.

This example shows how to determine value of startup query interval, other querier interval, group membership interval.

- Startup Query Interval = Query Interval / 4
- Other Querier Interval = (Robustness Variable * Query Interval) + (Query Max-Response Timeout / 2)
- Group Membership Interval = (Robustness Variable * Query Interval) + Query Max-Response Timeout

Beginning in Enable mode, follow these steps to configure IGMP robustness variable.

	command	**purpose**
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface on which you want to configure IGMP last-member-query-count and enter interface configuration mode
Step 3	**ip igmp robustness-variable** <*2-7*>	Configure robustness variable

This example shows how to configure robustness variable 3 in the VLAN1.1 and 4 in the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp robustness-variable 3
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.2
```

```
DUT-1(config-if)#ip igmp robustness-variable 4
DUT-1(config-if)#end
```

Other querier interval means the time to stop IGMP querier in the VLAN by querier selection when receiving IGMP general query message from upstream routers. Other querier interval could be affected by the value of robustness variable, query interval, query max-response timeout, and you can configure directly the value of the variables.

This shows how to determine other querier interval, and default, minimum and maximum values

- Other Querier Interval = (Robustness Variable * Query Interval) + (Query Max-Response Timeout / 2), minimum (60sec), maximum (300sec)

Beginning in Enable mode, follow these steps to configure IGMP other querier interval.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface to ne configured and enter the interface configuration mode
Step 3	**ip igmp querier-timeout** <*60-300*>	Configure other querier interval

This example shows how to configure other querier interval 120sec in the VLAN1.1 and 150sec in the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp querier-timeout 120
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.2
DUT-1(config-if)#ip igmp querier-timeout 150
DUT-1(config-if)#end
DUT-1#
```

The query interval means an interval sending IGMP general query message.

This shows default, minimum and maximum values of query interval.

- Query Interval = default(125msec), minimum(1msec), maximum(180000msec)

Beginning in Enable mode, follow these steps to configure IGMP query interval.

	Command	Description
Step 1	**configure terminal**	Enter Global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface to be configured and enter interface configuration mode
Step 3	**ip igmp query-interval** <*1-18000*>	Configure IGMP Query Interval

This example shows how to configure the query interval 60sec in the VLAN1.1 and 250sec in the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp query-interval 60
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.2
DUT-1(config-if)#ip igmp query-interval 250
DUT-1(config-if)#exit
DUT-1(config)#end
DUT-1#
```

The query max response time means an effective time of query that queriers send. Only IGMP report message sent in query max response time is effective and this time is used for index of other-querier timeout and group membership interval.

This shows default, minimum and maximum values of query max response time

- Query Max Response Time = default(10sec), minimum(1sec), maximum(240sec)

Beginning in Enable mode, follow these steps to configure IGMP query max response time.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**interface** *if-name*	Specify the L3 interface to be configured and enter interface configuration mode
Step 3	**ip igmp query-max-response-time** *<1-240>*	Configure IGMP query max response time.

This example shows how to configure the query max response time 1sec in the VLAN1.1 and 20sec in the VLAN1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface vlan1.1
DUT-1(config-if)#ip igmp query-max-response-time 1
DUT-1(config-if)#exit
DUT-1(config)#interface vlan1.2
DUT-1(config-if)#ip igmp query-max-response-time 20
DUT-1(config-if)#end
```

11.5 Displaying IGMP Configuration

Beginning in Enable mode, follow these steps to display IGMP configuration.

	Command	Description
Step 1	**show ip igmp interface**	Display IGMP interface information
Step 2	**show ip igmp upstream-interface**	Display IGMP upstream (mrouter) interface information
Step 3	**show ip igmp downstream-interface**	Display IGMP downstream interface information

This example shows how to verify IGMP interface information, IGMP upstream (mrouter) information and IGMP downstream interface information.

```
DUT-1#show ip igmp interface
Interface vlan1.1
 IGMP Enabled, Active, Querier, Configured for version 2
 Internet address is 1.1.1.254
 IGMP query interval is 60 seconds
 IGMP Startup query interval is 15 seconds
 IGMP querier timeout is 120 seconds
 IGMP max query response time is 1 seconds
 Last member query response interval is 2000 milliseconds
 Last member query count is 4
 IGMP fast-leave enabled
 Group Membership interval is 376 seconds
 Unsolicited Report interval is 10 seconds
 Robustness Variable is 3
(omitted)
DUT-1#show ip igmp upstream-interface
IGMP Upstream-Interface
 Inteface vlan1.3.
DUT-1#show ip igmp downstream-interface
IGMP Downstream-Interfaces
 Interface vlan1.1
 Interface vlan1.2
DUT-1#
```

11.6 Displaying IGMP Group

To display IGMP group information, use the following command

Beginning in Enable mode, follow this step to display IGMP group information.

Command	Description
show ip igmp groups	Display IGMP Group information

The following is an example displaying IGMP group information.

```
DUT-1#show ip igmp groups
IGMP Snooping Connected Group Membership
Group Address    Interface          Uptime   Expires   Last Reporter
225.100.100.101   vlan1.1           00:01:26  00:03:15 1.1.1.21
225.100.100.102   vlan1.1           00:01:23  00:03:12 1.1.1.21
225.100.100.103   vlan1.1           00:01:23  00:03:12 1.1.1.21
225.100.100.104   vlan1.1           00:01:22  00:03:11 1.1.1.21
225.100.100.105   vlan1.1           00:01:21  00:03:10 1.1.1.21
225.100.100.106   vlan1.1           00:01:21  00:03:10 1.1.1.21
225.100.100.107   vlan1.1           00:01:21  00:03:10 1.1.1.21
225.100.100.108   vlan1.1           00:01:20  00:03:09 1.1.1.21
DUT-1#
```

11.7 Understanding IGMP Proxy

The purpose of IGMP proxy is to manage effectively IGMP groups using a small set of IGMP messages. The IGMP proxy does not forward IGMP query receiving from mrouter to the ports in the VLANs, but perform IGMP report for the IGMP group in mrouter. This report names IGMP proxy report. The querier in the VLAN sends IGMP query to hosts, and sends IGMP report/leave message to mrouter only when new group is generated or removed.

VX-MD3024 system supports IGMP proxy function for reducing unnecessary IGMP-related process of the upstream L3 switches/routers, while IP address must be assigned in the VLAN. The IGMP proxy can be performed only in NMRP mode.

VX-MD3024 supports proxy report and report/leave suppression functions for IGMP proxy.

11.8 Configuring IGMP Proxy

Beginning in Enable mode, follow these steps to configure IGMP proxy.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**ip igmp proxy**	Enable IGMP Proxy

This example shows how to enable IGMP proxy.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip igmp proxy
DUT-1(config)#end
DUT-1#show ip igmp proxy
IGMP Proxy is Enabled.
DUT-1#
```

Chapter 12 Configuring Filter with ACL

This chapter describes how to configure filtering on your system by using access control lists (ACLs), which are also referred to in commands and tables as access lists.

This chapter consists of these sections:

- Understanding ACLs
- Configuring IP ACLs
- Configuring MAC ACLs
- Displaying ACL Information

12.1 Understanding ACLs

Packet filtering can help limit network traffic and restrict network use by certain users or devices. ACLs can filter traffic as it passes through a router and permit or deny packets at specified interfaces. An ACL is a sequential collection of permit and deny conditions that apply to packets. When a packet is received on an interface, the system compares the fields in the packet against any applied ACLs to verify that the packet has the required permissions to be forwarded, based on the criteria specified in the access lists. It tests packets against the conditions in an access list one by one. The first match determines whether the system accepts or rejects the packets. Because the system stops testing conditions after the first match, the order of the conditions in the list is critical. If no conditions match, the system rejects the packets.

An ACL contains an ordered list of access control entries (ACEs). Each ACE specifies permit or deny and a set of conditions the packet must satisfy in order to match the ACE. The meaning of permit or deny depends on the context in which the ACL is used.

VX-MD3024 system supports two types of ACLs:

- ✓ IP ACLs filter IP traffic, including TCP, UDP, IGMP and ICMP
- ✓ Ethernet or MAC ACLs filter non-IP traffic.

Applying ACL

ACLs in the VX-MD3024 system access-control traffic entering a Layer 2 interface. You can apply only one IP access list and one MAC access list to a Layer 2 interface. ACLs are supported on physical interfaces only and not on EtherChannel interfaces.

With ACLs, you can filter IP traffic by using IP access lists and non-IP traffic by using MAC addresses. You can filter both IP and non-IP traffic on the same Layer 2 interface by applying both an IP access list and a MAC access list to the interface.

Caution You cannot apply more than one IP access list and one MAC access list to a Layer 2 interface. If an IP access list or MAC access list is already configured on a Layer 2 interface and you apply a new IP

access list or MAC access list to the interface, the new ACL replaces the previously configured one.

Handling Fragmented Traffic

IP packets can be fragmented as they cross the network. When this happens, only the fragment containing the beginning of the packet contains the Layer 4 information, such as TCP or UDP port numbers. All other fragments are missing this information.

Some ACEs do not check Layer 4 information and therefore can be applied to all packet fragments. ACEs do test Layer 4 information cannot be applied in the standard manner to most of the fragments in a fragmented IP packet.

The ACEs specify Layer 4 information only be applied to the first fragment IP packet, and it is not applied to the other fragments.

12.2 Configuring IP ACL

This section describes how to configure IP ACL and apply it to an interface.

Creating IP ACL

You can identify IP ACLs with an alphanumeric string (a name). Beginning in Enable Mode, follow these steps to create a IP ACL.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2a	**ip access-list** access-list-name **{deny | permit}** protocol source source-wildcard destination destination-wildcard **[{precedence** precedence **| tos** tos **| dscp** dscp **| cos** cos**}]**	Define an IP access list and the access conditions. The *access-list-name* is a alphanumeric string. Enter **deny** or **permit** to specify whether to deny or to permit the packet if conditions are matched. For *protocol*, enter the name or number of an IP protocol: **icmp, igmp, udp, tcp** or **ip** or an integer in the range 0 to 255 representing an IP protocol number. To match any Internet

	Command	Description
		protocol (including ICMP, TCP and UDP) use the keyword **ip**. The *source* is the number of the network or host from which the packet is sent. The *source-wildcard* applies wildcard bits to the source. The *destination* is the network or host number to which the packet is sent. The *destination-wildcard* applies wildcard bits to the destination. Source, source-wildcard, destination, destination-wildcard can be specified as: The 32 bit quantity in dotted-decimal format. The keyword **any** for 0.0.0.0 255.255.255.255 (any host). The keyword **host** for a single host 0.0.0.0. The other keywords are optional and have these meanings. **precedence**: Enter to match packets with a precedence level specified as a number from 0 to 7. **tos**: Enter to match by type of service level, specified by a number from 0 to 15. **cos**: Enter to match packets with the CoS Value specified by a number from 0 to 7. **dscp**: Enter to match packets with the DSCP value specified by a number from 0 to 63.
or	**ip access-list** *access-list-name* **{deny | permit}** *protocol* **any any** [{**precedence** *precedence* | **tos** *tos* | **dscp** *dscp* | **cos** *cos*}]	In access-list configuration mode, define an IP access list using an abbreviation for a source and source wildcard of 0.0.0.0 255.255.255.255 and an abbreviation for a destination and destination wildcard of 0.0.0.0 255.255.255.255. You can use the **any** keyword in place of source and destination address and wildcard.
or	**ip access-list** *access-list-name* **{deny | permit}** *protocol* **host** *source* **host** *destination* [{**precedence** *precedence* | **tos** *tos* | **dscp** *dscp* | **cos** *cos*}]	Define an IP access list using an abbreviation for a source and source wildcard of *source* 0.0.0.0 and an abbreviation for a destination and destination wildcard of *destination* 0.0.0.0. You can use the **host** keyword in place of source and destination wildcard or mask.
Step 2b	**ip access-list** access-list-name **{deny | permit} {tcp | udp } [ihl**	You can enter **tcp** or **udp** in the *protocol* field to create TCP access list and UDP access list.

	Command	Description
	header-length**]** *source source-wildcard* [**eq** *port*] *destination destination-wildcard* [**eq** *port*] **[{precedence** *precedence* **| tos** *tos* **| dscp** *dscp* **| cos** *cos***}]**	The parameters are the same as those described in Step 2a with these exceptions: (Optional) Enter **ihl** *header-length* to specify the length of the IP Header. (Optional) Enter **eq** *port* to compare source (if positioned after *source source-wildcard*) or destination (if positioned after *destination destination-wildcard*) port.
Step 3	**end**	Return to Enable mode.
Step 4	**show ip access-list**	Verify the access list configuration.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

Use the **no ip access-list** *access-list-name* global configuration command to delete the entire access list.

This example shows how to create and display IP access list to deny Telnet access from any host in network 171.69.198.0 to any host in network 172.20.52.0 and permit any others.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip access-list telnet_filter deny tcp 171.69.198.0 0.0.0.255
172.20.52.0 0.0.0.255 eq telnet
DUT-1(config)#ip access-list telnet_filter permit tcp any any
DUT-1(config)#end
DUT-1#show ip access-list
VERSA IP access list telnet_filter
   deny   tcp 171.69.198.0 0.0.0.255 172.20.52.0 0.0.0.255 eq 23
   permit tcp any any
DUT-1#
```

After an ACL is created, any additions (possibly entered from the terminal) are placed at the end of the list.

After creating an ACL, you must apply it to a Layer 2 interface, as described in the "Applying an IP

ACL to an Interface" section.

Applying an IP ACL to an Interface

After you create an IP ACL, you can apply it to one or more interface. ACLs can be applied only to inbound Layer 2 interfaces.

Beginning in Enable mode, follow these steps to apply an IP access list to control access to a Layer 2 interface.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**ip access-group** *access-list-name* **in**	Control access to the specified interface by using the IP access list.
Step 4	**end**	Return to Enable mode.
Step 5	**show running-config**	Display the access list configuration.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

To remove the specified access group, use the **no ip access-group** *acess-list-name* **in** interface configuration command.

This example shows how to apply telnet_filter IP access list on fe1.1 to filter packets entering the interface:

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#ip access-group telnet_filter in
DUT-1(config-if)#end
DUT-1#show running-config interface fe1.1
!
```

```
interface fe1.1
 switchport
 bridge-group 1
 switchport mode access
 ip access-group telnet_filter in
!
DUT-1#
```

12.3 Configuring MAC ACL

You can filter non-IP traffic on a physical Layer 2 interface.

Creating MAC ACL

The procedure is similar to that of configuring IP ACLs. Beginning in Enable mode, follow these steps to create a MAC ACL.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**mac access-list** *access-list-name* **{permit | deny} {any | host** *source MAC address* **|** *source MAC address mask* **} {any | host** *destination MAC address* **|** *destination MAC address mask* **} [***ethertype***] [cos** *cos***]**	Define an MAC access list and the access conditions. The *access-list-name* specifies the name of MAC access list. Enter **deny** or **permit** to specify whether to deny or to permit the packet if conditions are matched. Specify **any** source MAC address, source MAC address with a mask or a specific **host** source MAC address and any destination MAC address, destination MAC address with a mask, or a specific destination MAC address. (Optional) You can also enter these options: - *ethertype*: An arbitrary EtherType number of a packet with Ethernet II or SNAP encapsulation in hex. - **cos** *cos*: An IEEE 802.1Q cost of service number from 0 to 7 used to set priority.
Step 3	**end**	Return to Enable mode.

	Command	Description
Step 4	**show mac access-list**	Show the access list configuration.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

Use the **no mac access-list** *access-list-name* global configuration command to delete the entire ACL. You can also delete individual ACEs from the IP or MAC ACLs.

This example shows how to create and display an access list named *mac_filter*, denying only EtherType 0x0806 traffic, but permitting all other types of traffic.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#mac access-list mac_filter permit any any 0x0806
DUT-1(config)#end
DUT-1#show mac access-list
VERSA MAC access list mac_filter
    permit any any 0x0806
DUT-1#
```

Applying a MAC ACL to a Layer 2 Interface

After you create a MAC ACL, you can apply it to a Layer 2 interface to filter non-IP traffic coming into that interface.

Beginning in Enable mode, follow these steps to apply a MAC ACL to control access to a Layer 2 interface.

Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Identify a specific interface for configuration, and enter interface configuration mode.
Step 3	**mac access-group** *access-list-name* **in**	Control access to the specified interface by using the MAC access list.

Step 4	**end**	Return to Enable mode.
Step 5	**show running-config** [**interface** *interface-id*]	Show the access list configuration.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

To remove the specified access group, use the **no mac access-group** *acess-list-name* **in** command in interface configuration mode.

This example shows how to apply MAC ACL mac_filter on fe1.1 to filter packets entering the interface.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#interface fe1.1
DUT-1(config-if)#mac access-group mac_filter in
DUT-1(config-if)#end
DUT-1#show running-config interface fe1.1
!
interface fe1.1
 switchport
 bridge-group 1
 switchport mode access
 mac access-group mac_filter in
 ip access-group telnet_filter in
!
DUT-1#
```

Chapter 13 Configuring QoS

This chapter describes how to configure quality of service (QoS) by using standard QoS command.

This chapter consists of these sections:

- Understanding QoS
- Class Map and Policy Map
- Configuring QoS
- Configuring Queue Operation
- Displaying QoS Information

13.1 Understanding QoS

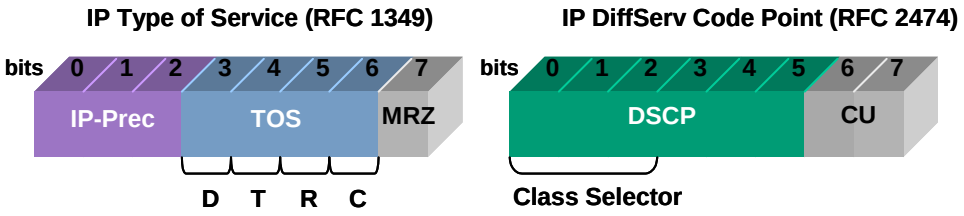
Typically, networks operate on a best-effort delivery basis, which means that all traffic has equal priority and an equal chance of being delivered in a timely manner. When congestion occurs, all traffic has an equal chance of being dropped.

When you configure QoS, you can select specific network traffic, prioritize it according to its relative importance, and use congestion-management and congestion-avoidance techniques to provide preferential treatment. Implementing QoS in your network makes network performance more predictable and bandwidth utilization more effective.

The QoS mechanism specifies that each packet is classified upon entry into the network. The classification is carried in the IP packet header, using 6 bits from the deprecated IP type of service (TOS) field to carry the classification (class) information. Classification can also be carried in the Layer 2 frame. These special bits in the Layer 2 frame or in the Layer 3 packet are described here.

- ✓ Prioritization in Layer 2 frames
  - Layer 2 802.1Q frame headers have a 2 byte Tag Control Information field that carries the CoS value in the three most-significant bits, which are called User Priority bits.
  - Layer 2 CoS values range from 0 for low priority to 7 for high priority.

- ✓ Prioritization in Layer 3 packets
  - Layer 3 IP packets can carry either an IP precedence value or a Differentiated Services Code Point (DSCP) value. QoS supports the use of either value because DSCP values are backward-compatible with IP precedence value.
  - IP precedence values range from 0 to 7.
  - DSCP values range from 0 to 63.



- MRZ: Must Be Zero
- T : Maximum Throughput
- C : Minimize Cost
- D : Minimum Delay
- R : Maximum Reliability
- CU : Currently Unused

To provide the same forwarding treatment to packets with the same class information and different treatment to packets with different class information, all switches and routers that access the Internet rely on class information. Class information in the packet can be assigned by end hosts or by switches or routers along the way, based on a configured policy, detailed examination of the packet, or both. Detailed examination of the packet is expected to happen closer to the network edge so that core switches and routers are not overloaded.

Switches and routers along the path can use class information to limit the amount of resources allocated per traffic class. The behavior of an individual device when handling traffic in the DiffServ architecture is called per-hop behavior. If all devices along a path provide a consistent per-hop behavior, you can construct an end-to-end QoS solution.

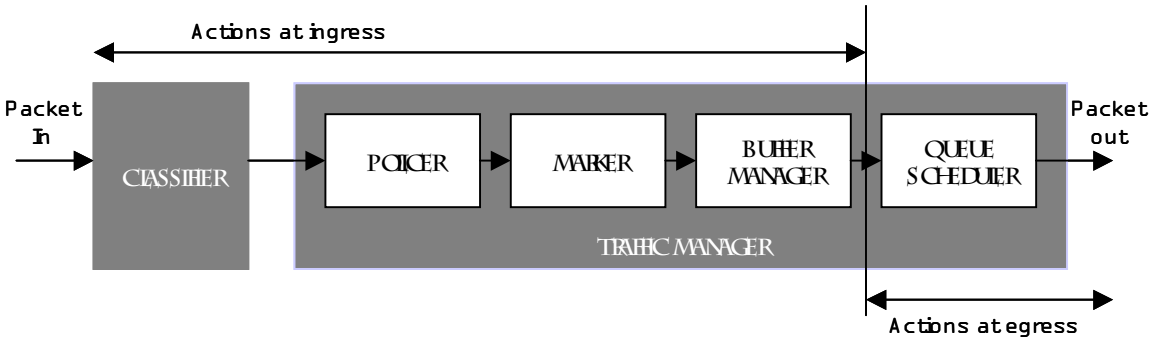
Basic QoS Model

The following figure shows the basic QoS model. Actions at the ingress interface include classifying traffic, policing, and marking:

- Classifying distinguishes one kind of traffic from another. The process generates an internal DSCP for a packet, which identifies all the future QoS actions to be performed on this packet.
- Policing determines whether a packet is in or out of profile by comparing the internal DSCP to the configured policer. The policer limits the bandwidth consumed by a flow of traffic. The result of this determination is passed to the marker.
- Marking evaluates the policer and the configuration information for the action to be taken when a packet is out of profile and decides what to do with the packet.

Actions at the egress interface include queueing and scheduling:

- Queueing evaluates the internal priority information and determines which of the four egress queues in which to place the packet. The priority information is mapped to Cos value, which selects one of the queues.
- Scheduling services the four egress queues based on their configured weighted round robin (WRR) weights and thresholds. One of the queues can be the expedite queue, which is serviced until empty before the other queues are serviced. Congestion avoidance techniques include tail drop and Weighted Random Early Detection (WRED).



13.2 Class Maps and Policy Maps

You can configure QoS service policy by using class map and policy map. A class map consists of criteria for classifying traffic into several classes. A policy map consists of classes which have actions to apply to the traffic class.

This section describes class maps and policy maps.

Class Maps

You can use IP ACL and MAC ACLs to define a group of packets with the same characteristics (class). In the QoS context, the permit and deny actions in the access control entries (ACEs) have different meanings than with filtering ACLs:

- If a match with a permit action is encountered (first-match principle), the specified QoS-related action is taken.
- If a match with a deny action is encountered, the ACL being processed is skipped, and the next ACL is processed.
- If no match with a permit action is encountered and all the ACEs have been examined, no QoS processing occurs on the packet, and the system offers best-effort service to the packet.
- If multiple ACLs are configured on an interface, the lookup stops after the packet matches the first ACL with a permit action, and QoS processing begins.

A class map is a mechanism that you use to name and to isolate a specific traffic flow (or class) from all other traffic. The class map defines the criteria used to match against a specific traffic flow to further classify it. The criteria can include matching the access group defined by ACL, matching a specific list of DSCP or IP precedence values, or matching a specific list of VLAN IDs. If you have more than one type of traffic that you want to classify, you can create another class map and use a different name. After a packet is matched against the class-map criteria, you further classify it through the use of a policy map.

Policy Maps

After a traffic class has been defined with the ACL, you can attach a policy to it. A policy might contain multiple classes with actions specified for each one of them.

A policy map specifies which traffic class to act on. Actions can include trusting the CoS, DSCP, or IP precedence values in the traffic class; setting a specific DSCP or IP precedence value in the traffic class; or specifying the traffic bandwidth limitations and the action to take when the traffic is out of profile.

This policy is then attached to a particular port on which it becomes effective.

13.3 Configuring QoS

This section describes how to configure QoS on your system.

Default QoS Configuration

The following table shows the default QoS configuration when QoS is disabled.

Feature	Default Setting
QoS Status	Disabled

Egress traffic (CoS Value)	Pass through
Default CoS	-
Queuing	-
CoS Mapping to Queue	All CoS values map to queue 1.

The following table shows the default QoS configuration when QoS is enabled.

Feature	Default Setting
QoS Status	Enabled
Egress traffic (CoS Value)	Pass through
Default CoS	0
Queuing	Strict Priority-based Queue (SPQ)
CoS Mapping to Queue	0, 1: Queue 1 2, 3: Queue 2 4, 5: Queue 3 6, 7: Queue 4

QoS Configuration Guidelines

Before beginning the QoS configuration, you should be aware of this information:

- You must disable the IEEE 802.3X flow control on all ports before enabling QoS on the system. To disable it, use **flowcontrol receive off** and **flowcontrol send off** commands in the interface configuration mode.
- Only one ACL per class map and only one **match** class-map configuration command per class map are supported. The ACL can have multiple access control entries, which are commands that match fields against the contents of the packet.
- It is not possible to match IP fragments against configured IP ACLs with Layer 4 information to enforce QoS. IP fragments are sent as best-effort. IP fragements are denoted by fields in the IP header.
- You can configure a policer on an ingress or egress physical port
- All ingress QoS processing actions apply to control traffic (such as spanning-tree bridge

protocol data units [BPDUs] and routing update packets) that the system receives.

Enabling QoS Globally

By default, QoS is disabled on the system, which means that the system offers best-effort service to each packet regardless of the packet contents or size. All CoS values map to egress queue 1 with tail-drop thresholds set to 100 percent of the total queue size.

Beginning in Enable mode, follow these steps to enable QoS.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service qos**	Enable QoS globally.
Step 3	**end**	Return to Enable mode.
Step 4	**show qos**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

After QoS is enabled, the default settings are as shown in “Default QoS Configuration” section.

To disable QoS, use the **no service qos** command in global configuration mode.

Configuring a QoS Policy

Configuring a QoS policy typically requires classifying traffic into classes, configuring policies applied to those traffic classes, and attaching policies to interfaces.

These sections how to configure a QoS policy:

- ✓ Classifying Traffic by Using ACLs
- ✓ Classifying Traffic by Using Class Maps
- ✓ Classifying, Policing, and Marking Traffic by Using Policy Maps

(1) Classifying Traffic by Using ACLs

You can classify IP traffic by using IP ACLs; you can classify non-IP traffic by using Layer 2 MAC ACLs.

Beginning in Enable mode, follow these steps to create an IP ACL for IP traffic

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service qos**	Enable QoS globally.
Step 3	**ip access-list** access-list-name **{deny | permit}** protocol source source-wildcard destination destination-wildcard **[{precedence** precedence **| tos** tos **| dscp** dscp **| cos** cos**}]**	Define an IP access list and the access conditions. The *access-list-name* is a alphanumeric string. Enter **deny** or **permit** to specify whether to deny or to permit the packet if conditions are matched. For *protocol*, enter the name or number of an IP protocol: **icmp, igmp, udp, tcp** or **ip** or an integer in the range 0 to 255 representing an IP protocol number. To match any Internet protocol (including ICMP, TCP and UDP) use the keyword **ip**. The *source* is the number of the network or host from which the packet is sent The *source-wildcard* applies wildcard bits to the source. The *destination* is the network or host number to which the packet is sent. The *destination-wildcard* applies wildcard bits to the destination. Source, source-wildcard, destination, destination-wildcard can be specified as: The 32 bit quantity in dotted-decimal format. The keyword **any** for 0.0.0.0 255.255.255.255 (any host). The keyword **host** for a single host 0.0.0.0. The other keywords are optional and have these meanings. **precedence**: Enter to match packets with a precedence level specified as a number from 0 to 7. **tos**: Enter to match by type of service level, specified by a number from 0 to 15. **cos**: Enter to match packets with the CoS Value specified by a number from 0 to 7. **dscp**: Enter to match packets with the DSCP value specified by

	Command	Description
		a number from 0 to 63. **Note** When creating an access list, remember that, by default, the end of the access list contains an implicit deny statement for everything if it did not find a match before reaching the end.
Step 4	**end**	Return to Enable mode.
Step 5	**show ip access-list**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

To delete an access list, use the **no access-list** *access-list-name* command in global configuration mode.

This example shows how to create IP ACL that permits IP traffic with a DSCP value set to 32 from any source to any destination:

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip access-list dscp_filter permit ip any any dscp 32
DUT-1(config)#end
DUT-1#
```

This example shows how to create an ACL that permit IP traffic with a precedence value 5 from a source host at 10.1.1.1 to a destination host at 10.1.1.2.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip access-list prec_filter permit ip host 10.1.1.1 host
10.1.1.2 precedence 5
DUT-1(config)#end
DUT-1#
```

(2) Classifying Traffic by Using Class Map

You use the class map global configuration command to name and to isolate a specific traffic flow (or class) from all other traffic. The class map defines the criteria to use to match against a specific traffic flow to further classify it. Match statements can include criterion such as an ACL, IP precedence values, or DSCP values. The match criterion is defined with one match statement entered within the class map configuration mode.

Beginning in Enable mode, follow these steps to create a class map and to define the match criterion to classify traffic on a physical port basis.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service qos**	Enable QoS globally.
Step 3	**ip access-list** *access-list-name* **{deny | permit}** *protocol source source-wildcard destination destination-wildcard* or **mac access-list** *access-list-name* **{permit | deny}** *source MAC address mask destination MAC address mask* **[***ethertype***] [cos** cos**]**	Create an IP ACL for IP traffic or a Layer 2 MAC ACL for non-IP traffic, repeating the commands as many times as necessary. For more detail information, see the Chapter 12, “Configuring Filter by Using ACL” **Note** When creating an access list, remember that, by default, the end of the access list contains an implicit deny statement for everything if it did not find a match before reaching the end.
Step 4	**class-map** *class-map-name*	Create a class map, and enter class-map configuration mode. By default, no class maps are defined. For *class-map-name*, specify the name of the class map.
Step 5	**match {access-group** *acl-name* **| ip dscp** *dscp-list* **| ip precedence** *ip-precedence-list***}**	Define the match criterion to classify traffic. By default, no match criterion is defined. Only one match criterion per class map is supported, and only one ACL per class map is supported. - For **access-group** *acl-name*, specify the name of the ACL created in Step 3 - For **ip dscp** *dscp-list*, enter a list of up to 4 IP DSCP values to match against incoming packets. Separate each value with a space. The range is 0 to 63. - For **ip precedence** *ip-precedence-list*, enter a list of up to 4

	Command	Description
		IP-precedence values to match against incoming packets. Separate each value with white space. The range is 0 to 7.
Step 6	**end**	Return to Enable mode.
Step 7	**show ip access-list**	Verify your entries.
Step 8	**write memory**	(Optional) Save your entries in the configuration file.

To delete an existing class map, use the **no class-map** *class-map-name* command in global configuration mode. To remove a match criterion, use the **no match {access-group** *acl-name* **| ip dscp | ip precedence}** command in class-map configuration mode.

This example shows how to configure the class map called class1. The class1 has one match criterion, whose name is test_a . It permits traffic that matches a DSCP value of 10 from any host to any destination.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip access-list test_acl permit ip any any dscp 10
DUT-1(config)#class-map class1
new class-map(class1) created
DUT-1(config-class-map)#match ip access-group test_acl
DUT-1(config-class-map)#end
DUT-1#
```

(3) Classifying, Policing and Marking Traffic by Using Policy Map

A Policy Map specifies which traffic class to act on. Actions can include trusting the CoS, DSCP, or IP precedence values in the traffic class; setting a specific DSCP or IP precedence value in the traffic class; and specifying the traffic bandwidth limitations for each matched traffic class (policer) and the actions to take (marking) when the traffic is out of profile.

Only one policy map per interface per direction is supported. You can apply the same policy map to multiple interfaces and directions.

Beginning in Enable mode, follow these steps to create a policy map.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service qos**	Enable QoS globally.
Step 3	**ip access-list** *access-list-name* **{deny | permit}** *protocol source source-wildcard destination destination-wildcard* or **mac access-list** *access-list-name* **{permit | deny}** *source MAC address mask destination MAC address mask* **[***ethertype***] [cos** cos**]**	Create an IP ACL for IP traffic or a Layer 2 MAC ACL for non-IP traffic, repeating the commands as many times as necessary. For more detail information, see the Chapter 12, “Configuring Filter by Using ACL” **Note** When creating an access list, remember that, by default, the end of the access list contains an implicit deny statement for everything if it did not find a match before reaching the end
Step 4	**class-map** *class-map-name*	Create a class map to classify traffic as necessary. For more information, see “Classifying Traffic by Using Class Map”.
Step 5	**policy-map** *policy-map-name*	Create a policy map by entering the policy map name, and enter policy-map configuration mode. By default, no policy maps are defined.
Step 6	**class** *class-map-name*	Define a traffic classification, and enter policy-map class configuration mdoe. By default, no policy map class-maps are defined. If a traffic class has already been defined by using the **class-map** global configuration mode, specify its name for *class-map-name* in this command.
Step 7	**trust {cos | ip-precedence}**	Configure the trust state, which selects the value that QoS uses as the source of the internal priority value. This command is mutually exclusive with the **set** command within the same policy map. If you enter the **trust** command, then skip Step 7. The keywords have these meanings: - **cos**: QoS derives the internal priority value by using the received or default port CoS value. - **ip-precedence**: QoS derives the internal priority value by using the IP precedence value from the ingress packet
Step 8	**set {drop-precedence | cos** *new-cos* **| ip dscp** *new-dscp* **| ip**	Classify IP traffic by setting a new value in the packet. - **drop-precedence**: Enable drop-precedence function.

	Command	Description
	precedence *new-precedence***}**	- For **cos** *new-cos*: Enter a new CoS value to be assigned to the classified traffic. The range is 0 to 7. - For **ip dscp** *new-dscp*: Enter a new DSCP value to be assigned to the classified traffic. The range is 0 to 63. - For **ip precedence** *new-precedence*: enter a new IP-precedence value to be assigned to the classified traffic. The range is 0 to 7.
Step 9	**police** *rate-kbps burst-kbits* **exceed-action {drop | mark dscp** *new-dscp* **| mark drop-precedence}**	Define a policer for the classified traffic. - For *rate-kbps*, specify average allowed traffic rate in kbps. The range is 64 to 1048512. You can select values which are 64 times only. - For *burst-kbits*, specify the normal burst size in kilo bits. The range is 32 to 4096. You can select the values which are 32 times only. **Note** Although the command-line help strings show a large range of values, the rate-kbps option cannot exceed the configured port speed. Specify the action to take when the rates are exceeded. - **drop**: drop the packets. - **mark dscp** *new-dscp*: mark new DSCP value and send the packets. - **mark drop-precedence**: mark the congestion field of the packets to discard when it happens congestion.
Step 10	**exit**	Return to policy map configuration mode.
Step 11	**exit**	Return to global configuration mode.
Step 12	**interface** *interface-id*	Enter interface configuration mode, and specify the interface to attach to the policy map. Valid interfaces include physical interfaces.
Step 13	**service-policy {input** *policy-map-name* **| output** *policy-map-name***}**	Apply a policy map to the input or output of a particular interface. Only one policy map per interface per direction is supported. - Use **input** *policy-map-name* to apply the specified policy-map to the input of an interface. - Use **output** *policy-map-name* to apply the specified policy-

	Command	Description
		map to the output of an interface.
Step 14	**end**	Return to Enable mode.
Step 15	**show policy-map [***policy-map-name***]**	Verify your entries.
Step 16	**write memory**	(Optional) Save your entries in the configuration file.

To delete an existing policy map, use the **no policy-map** *policy-map-name* command in global configuration mode. To return to the default trust state, use the **no trust** command in policy-map configuration command. To remove an assigned DSCP or IP precedence value, use the **no set {drop-precedence** *new-precedence* **| cos** *new-cos* **| ip dscp** *new-dscp* **| ip precedence** *new-precedence***}** command in policy-map configuration mode. To remove an existing policer, use the **no police** command in policy-map configuration mode. To remove the policy map and interface association, use the **no service-policy** {*input* | o*utput*} command in interface configuration mode.

This example shows how to create a policy map and attach it to an ingress interface. In the configuration, the IP ACL permits traffic with an IP precedence of 4 from any host destined for the host at 224.0.0.5. For traffic matching this classification, the DSCP value in the incoming packet is set to 63.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#ip access-list test_acl1 permit tcp any host 224.0.0.5
precedence 4
DUT-1(config)#class-map ipclass1
new class-map(ipclass1) created
DUT-1(config-class-map)#match ip access-group test_acl1
DUT-1(config-class-map)#exit
DUT-1(config)#policy-map ip_pol1
new policy-map(ip_pol1) created
DUT-1(config-policy-map)#class ipclass1
DUT-1(config-pmap-class)#set ip dscp 63
DUT-1(config-pmap-class)#exit
DUT-1(config-policy-map)#exit
DUT-1(config)#interface fe2.1
DUT-1(config-if)#service-policy input ip_pol1
DUT-1(config-if)#end
```

```
DUT-1#
```

This example shows how to create a Layer 2 MAC ACL with two permit statements and attach it to an ingress interface. The first permit statement allows traffic from the host with MAC address 0001.0000.0001 destined for the host with MAC address 0002.0000.0001. The second permit statement allows from the host with MAC address 0001.0000.0002 destined for the host with MAC address 0002.0000.0002.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#mac access-list maclist1 permit host 0001.0000.0001 host
0002.0000.0001
DUT-1(config)#mac access-list maclist1 permit host 0001.0000.0002 host
0002.0000.0002
DUT-1(config)#mac access-list maclist2 permit host 0001.0000.0003 host
0002.0000.0003
DUT-1(config)#mac access-list maclist2 permit host 0001.0000.0004 host
0002.0000.0004
DUT-1(config)#class-map macclass1
new class-map(macclass1) created
DUT-1(config-class-map)#match mac access-group maclist1
DUT-1(config-class-map)#exit
DUT-1(config)#class-map macclass2
new class-map(macclass2) created
DUT-1(config-class-map)#match mac access-group maclist2
DUT-1(config-class-map)#exit
DUT-1(config)#policy-map macpolicy1
new policy-map(macpolicy1) created
DUT-1(config-policy-map)#class macclass1
DUT-1(config-pmap-class)#set cos 7
DUT-1(config-pmap-class)#exit
DUT-1(config-policy-map)#class macclass2
DUT-1(config-pmap-class)#set cos 4
DUT-1(config-pmap-class)#exit
DUT-1(config-policy-map)#exit
DUT-1(config)#interface fe2.2
DUT-1(config-if)#service-policy input macpolicy1
DUT-1(config-if)#end
DUT-1#
```

13.4 Configuring Queue Operation

This section describes how to configure queue operation. This section contains this configuration information.

- ✓ Configuring CoS-Queue Map
- ✓ Configuring Queue Scheduling

Configuring CoS-Queue Map

You can configure the CoS-Queue Map. Beginning in Enable mode, follow these steps to map CoS ingress values to select one of the egress queue.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service qos**	Enable QoS globally.
Step 3	**qos cos-queue map cos** *cos* **queue** *queue-id*	Map assigned a CoS value to select one of the egress queue. The default map has these values: - CoS 0, 1: selects Queue 1 - CoS 2, 3: selects Queue 2 - CoS 4, 5: selects Queue 3 - CoS 6, 7: selects Queue 4 For *cos*, specify the CoS value that select a queue. The range is 0 to 7 For *queue-id*, specify the ID of the egress queue. The range is 1 to 4.
Step 4	**end**	Return to Enable mode.
Step 5	**show qos [cos-queue-map]**	Verify your entries.
Step 6	**write memory**	(Optional) Save your entries in the configuration file.

To return the default CoS-to-egress-queue map, use the **no cos-queue map** command in global

configuration mode.

This example shows how to map CoS values 6 and 7 to queue 1, 4 and 5 to queue 2, 2 and 3 to queue 3, 0 and 1 to queue 4.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#qos cos-queue map cos 7 queue 0
DUT-1(config)#qos cos-queue map cos 6 queue 0
DUT-1(config)#qos cos-queue map cos 5 queue 1
DUT-1(config)#qos cos-queue map cos 4 queue 1
DUT-1(config)#qos cos-queue map cos 3 queue 2
DUT-1(config)#qos cos-queue map cos 2 queue 2
DUT-1(config)#qos cos-queue map cos 1 queue 3
DUT-1(config)#qos cos-queue map cos 0 queue 3
DUT-1(config)#end
DUT-1#show qos cos-queue-map
Cos-Queue Map(Queues in use: 4)
 0 - 3
 1 - 3
 2 - 2
 3 - 2
 4 - 1
 5 - 1
 6 - 0
 7 - 0
DUT-1#
```

Configuring Queue Scheduling

VX-MD3024 System supports two types of queue scheduling method. The one is Strict Priority Queue (SPQ) and the other is Weighted Round Robin (WRR). The default queue scheduling method is SPQ.

Beginning in Enable mode, follow these steps to configure the queue scheduling method.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service qos**	Enable QoS globally.

	Command	Description
Step 3	**qos scheduling spq**	Select the queue scheduling method to SPQ. The default queue scheduling method is SPQ.
Step 4	**qos scheduling wrr weight** *weight0 weight1 weight2 weight3*	Select the queue scheduling method to WRR and assign WRR weights to the egress queue. For *weight0 weight1 weight2 weight3*, enter the ratio, which determines the ratio of the frequency in which the WRR scheduler dequeues packets. Separate each value with white space. The range is 1 to 15.
Step 5	**end**	Return to Enable mode.
Step 6	**show qos scheduling**	Verify your entries.
Step 7	**write memory**	(Optional) Save your entries in the configuration file.

This example shows how to configure the weight ratio of the WRR scheduler running on the egress queues. In this example, four queues are used and the ratio of the bandwidth allocated for each queue is 1/(1+2+3+4), 2/(1+2+3+4), 3/(1+2+3+4), and 4/(1+2+3+4), which is 1/10, 1/5, 3/10, and 2/5 for queues 1, 2, 3, and 4.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#qos scheduling wrr weight 1 2 3 4
DUT-1(config)#end
DUT-1#
```

13.5 Displaying QoS Information

To display QoS information, use use the following command in Enable mode.

Command	Description
show class-map [*class-map-name***]**	Display QoS class maps, which define the match criteria to classify traffic.
show policy-map [*policy-map-name***]**	Display QoS policy maps, which define classificataion criteria for incoming traffic.

show qos [{cos-queue-map | congestion-ctrl | scheduling}]	Display QoS information, including QoS status, the configuration of queue scheduling method and the weight of each queue and the CoS-to-egress queue map. If you specify the category that you want to show, the specified information would be displayed.

This example shows how to display the policy map.

```
DUT-1#show policy-map
Policy-map ip_pol1
 class ipclass1 [match ip access-group test_acl1]
  set ip dscp 63
Policy-map macpolicy1
 class macclass1 [match mac access-group maclist1]
  set cos 7
 class macclass2 [match mac access-group maclist2]
  set cos 4
DUT-1#
```

This example shows how to display the configured QoS information.

```
DUT-1#show qos
Queuing Mode: SPQ

Congestion Control Method : TailDrop
Cos-Queue Map(Queues in use: 4)
 0 - 0
 1 - 0
 2 - 3
 3 - 3
 4 - 2
 5 - 2
 6 - 1
 7 - 1
DUT-1#
```

Chapter 14 Configuring SNMP

This chapter describes how to configure Simple Network Management Protocol (SNMP) on your system.

This chapter consists of these sections:

- Understanding SNMP
- Configuring SNMP
- Displaying SNMP Status

14.1 Understanding SNMP

SNMP is an application-layer protocol that provides a message format for communication between managers and agents. The SNMP system consists of an SNMP manager, an SNMP agent, and a management information base (MIB). The SNMP manager can be part of a network management system (NMS). The agent and MIB reside on the system. To configure SNMP on the system, you define the relationship between the manager and the agent.

The SNMP agent contains MIB variables whose values the SNMP manager can request or change. A manager can get a value from an agent or store a value into the agent. The agent gathers data from the MIB, the repository for information about device parameters and network data. The agent can also respond to a manager's requests to get or set data.

An agent can send unsolicited traps to the manager. Traps are messages alerting the SNMP manager to a condition on the network. Traps can mean improper user authentication, restarts, link status (up or down) or other significant events.

This section includes information about these topics:

- ✓ SNMP Agent Functions
- ✓ SNMP Manager Functions
- ✓ SNMP Messages
- ✓ SNMP Community
- ✓ SNMP Notifications

SNMP Agent Functions

The SNMP agent is a network management module running in the managed device. The SNMP agent responds to SNMP manager requests as follows:

- Get a MIB variable: The SNMP agent initiates this function in response to a request from the NMS. The agent retrieves the value of the requested MIB variable and responds to the NMS with that value.
- Set a MIB variable: The SNMP agent initiates this function in response to a message from the NMS. The SNMP agent changes the value of the MIB variable to the value requested by the NMS.

The SNMP agent also sends unsolicited trap messages to notify an NMS that a significant event has occurred on the agent. Examples of traps conditions include, but are not limited to, when a port or module goes up or down, when spanning-tree topology changes occur, and when authentication failures occur.

The MIB is the information base, the SNMP agent must keep available for the managers. This information base contains objects whose values provide information on the status of the checked system or objects whose values can be modified by a manager to control the system. Each object is identified by an Object ID (OID). There are two kinds of MIBs, standard MIB and enterprise-specific MIB.

SNMP Manager Functions

SNMP Manager is an integrated management module which collects information from SNMP agent and sometimes sends warning messages depending on the each SNMP agent relations. In other words, the actual data is collected from SNMP agent and this data will be processed by management module and saved. To request information or configuration changes, respond to requests, and send unsolicited alerts, the SNMP manger and SNMP agent use the four messages (Get, GetNext, Set, trap).

SNMP Messages

The SNMP manager and SNMP agent use the following SNMP messages to request information or configuration changes, respond to requests, and send unsolicited alerts.

- Get Request / Get Response Message
- Get-Next Request / Get-Next Request Message
- Set Request Message
- Trap Message

(1) Get Request Message

Get-Request Message is the basic SNMP request message. Sent by an SNMP manager, it requests information about a single MIB entry on an SNMP agent. For example, the amount of free drive space.

(2) Get-Next Request Message

GetNext-Request Message is an extended type of request message that can be used to browse the entire tree of management objects. When processing a Get-next request for a particular object, the agent returns the identity and value of the object which logically follows the object from the request. The Get-next request is useful for dynamic tables, such as an internal IP route table.

(3) Set Request Message

If write access is permitted, Set-Request message can be used to send and assign an updated MIB value to the agent.

(4) Trap Message

An unsolicited message sent by an SNMP agent to an SNMP manager when the agent detects that a certain type of event has occurred locally on the managed device. For example, a trap message might be sent on a system restart event.

SNMP Community

SNMP community strings authenticate access to MIB objects and function as embedded passwords. In order for the NMS to access the system, the community string definitions on the NMS must match at least one of the two community string definitions on the system.

A community string can have one of the following attributes:

Types	Access Right
Read Only (RO)	Gives read access to authorized management stations to all objects in the MIB, but does not allow write access.
Read Write (RW)	Gives read and write access to authorized management stations to all objects in the MIB.

SNMP Notifications

SNMP allows the system to send notification to SNMP managers when particular events occur. SNMP notification can be sent as traps. Use the **snmp trap-receiver** commands to specify whether to send SNMP notifications as traps.

14.2 Configuring SNMP

This section describes how to configure SNMP on your system. It contains this configuration information.

- ✓ Default SNMP Configuration
- ✓ Configuring Community
- ✓ Configuring SNMP Trap-Receiver
- ✓ Configuring SNMP Trap
- ✓ Configuring SNMP Trap Source Interface

Default SNMP Configuration

The follow table shows default SNMP Configuration

Feature	Default Setting
SNMP agent	Enabled
SNMP Community	None configured
SNMP Trap Receiver	None configured
SNMP Traps	None enabled
SNMP Trap Source Interface	None configured. If SNMP trap source interface is not defined, the source IP address of each trap message's is the IP address of routed interface.

Configuring Community

You use the SNMP community string to define the relationship between the SNMP manager and the agent. The community string acts like a password to permit access to the agent on the system.

Beginning in Enable mode, follow these steps to configure a community string on the system.

	Command	Descriptioin
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**snmp community** *string* **{readonly | readwrite}**	Configure the community string. - For *string*, specify a string that acts like a password and permits access to the SNMP protocol. You can configure one or more community strings of any length. Specify either read-only if you want authorized management stations to retrieve MIB objects, or specify read-write if you want authorized management stations to retrieve and modify MIB objects.
Step 3	**end**	Return to Enable mode.
Step 4	**show snmp community**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

To remove a specific community string, use the **no snmp community** *string* command in global configuration mode.

This example shows how to assign the string *everyone* to SNMP, to allow read-only access, and administrator to allow read-write.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#snmp community everyone readonly
DUT-1(config)#snmp community administrator readwrite
DUT-1(config)#end
DUT-1#
```

Configuring SNMP Trap-Receiver

Trap receiver is the SNMP manager station to receive traps from an SNMP agent. Trap is the message sent by an SNMP agent to an NMS to indicate the occurrence of a significant event, such as a specifically defined condition or a threshold that was reached. By default, no trap receiver is configured. To receive the trap generated on your managed device using NMS, you must add the NMS as a trap receiver. You can specify up to 8 trap receivers on the VX-MD3024 system.

Beginning in Enable mode, follow these steps to add trap receivers.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**snmp trap-receiver** *ip-address community-string*	Specify the recipient of an SNMP trap operation. For *ip-address*, specify IP address of the targeted recipient. For *community-string*, enter the password-like community string sent with the notification operation.
Step 3	**end**	Return to Enable mode.
Step 4	**show snmp trap-receiver**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

To remove the specified trap receiver, use the **no snmp trap-receiver** *ip-address* command in global configuration mode.

This example shows how to add a SNMP trap receiver whose IP address is 192.168.100.100 and community string is public.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#snmp trap-receiver 192.168.100.100 public
DUT-1(config)#end
DUT-1#
```

Configuring SNMP Trap

There are many kinds of SNMP trap messages provided by SNMP on the VX-MD3024 system - config-change-trap, cpu-utilization-trap, dhcp-server-trap, ip-permit-denied-trap, link-up-down-trap, memory-utilization-trap and os-image-upgrade-trap.

Each trap message is shown in the following cases.

1. config-change-trap is shown when the configuration file is changed.
2. cpu-utilization-trap is shown when the cpu utilization threshold configured by user excess. Also when CPU utilization is down under the threshold, trap message will be sent to inform it.
3. dhcp-server-trap is shown when there is no more IP address can be assigned in subnet of DHCP server. Also when DHCP server starts and stops, this trap message will be sent to inform it.
4. ip-permit-denied trap is shown when the host which has unauthorized IP address access your system.
5. link-up-down-trap is shown when network of port is disconnected, or when the network is connected again.

6. memory-utilization-trap is shown when the memory utilization threshold configured by user excess. Also when memory utilization is down under the threshold, trap message will be sent to inform it.

7. os-image-upgrade-trap is shown when you finish OS image upgrade.

However, it may be inefficient work if all these trap messages are too frequently sent. Therefore, user can select type of trap sent to trap-host.

Use the following commands in global configuration mode to configure kinds of trap messages that you want to receive.

Command	Description
snmp trap config-change-trap	Configures **config-change-trap** message to be sent.
snmp trap cpu-utilization-trap	Configures **cpu-utilization-trap** message to be sent.
snmp trap dhcp-server-trap	Configures **dhcp-server-trap** message to be sent.
snmp trap ip-permit-denied-trap	Configures **ip-permit-denied-trap** message to be sent.
snmp trap link-up-down-trap	Configures **link-up-down-trap** message to be sent.
snmp trap memory-utilization-trap	Configures **memory-utilization-trap** message to be sent.
snmp trap os-image-upgrade-trap	Configures **os-image-upgrade-trap** message to be sent.
snmp trap chassis-trap	Configures **chassis-trap** message to be sent.
snmp trap environment-monitoring-trap	Configures **environment-monitoring-trap** message to be sent.
snmp trap gateway-ping-check-trap	Configures **gateway-ping-check-trap** message to be sent.

To block each kinds of trap messages to send a configured trap receiver, use the following commands in global configuration mode.

Command	Description

no snmp trap config-change-trap	Blocks **config-change-trap** message
no snmp trap cpu-utilization-trap	Blocks **cpu-utilization-trap** message
no snmp trap dhcp-server-trap	Blocks **dhcp-server-trap** message
no snmp trap ip-permit-denied-trap	Blocks **ip-permit-denied-trap** message
no snmp trap link-up-down-trap	Blocks **link-up-down-trap** message
no snmp trap memory-utilization-trap	Blocks **memory-utilization-trap** message
no snmp trap os-image-upgrade-trap	Blocks **os-image-upgrade-trap** message
no snmp trap chassis-trap	Blocks **chassis-trap** message
no snmp trap environment-monitoring-trap	Blocks **environment-monitoring-trap** message
no snmp trap gateway-ping-check-trap	Blocks **gateway-ping-check-trap** message

This example shows how to configure config-change-trap messages to be sent.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#snmp trap config-change-trap
DUT-1(config)#end
DUT-1#
```

Configuring SNMP Trap Source Interface

VX-MD3024 system can have several Layer 3 interface and IP address is assigned to the Layer 3 interfaces. Normally, to manage your network effectively you might use only one IP address that represents a system in your NMS system.

But, if there are several Layer 3 interfaces on your system, the source IP address of trap message that is sent from your system can be selected different IP address according to the routing information. In this case, when you receive trap messages on your NMS, you cannot identify which device sent it.

In order to solve this problem, you can configure the interface that is used for source IP address of all trap messages from your system.

Beginning in Enable mode, follow these steps to configure the source interface of trap messages on your system.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**snmp trap-source-interface** *interface-name*	Configure the source interface of trap messages. For *interface-name*, specify the name of the interface used for source interface of the SNMP trap messages.
Step 3	**end**	Return to Enable mode.
Step 4	**show snmp trap-receiver**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

To remove the configured source interface of trap message, use the **no snmp trap-source-interface** command in global configuration mode. To display the source interface of trap message information, use the **show snmp trap-receiver** command in Enable mode.

This example shows how to configure the source interface of trap message to vlan1.10, and verify the configuration.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#snmp trap-source-interface vlan1.10
DUT-1(config)#end
DUT-1#show snmp trap-receiver
************************************************************************
                        SNMP Trap Receiver List
************************************************************************
 ID         Community          IP Address
------------------------------------------------------------------------
  1             public        192.168.100.100
  2             public        210.121.174.215
------------------------------------------------------------------------
+ SNMP Trap source interface : vlan1.10(192.168.40.201)
------------------------------------------------------------------------
```

```
DUT-1#
```

14.3 Displaying SNMP Status

To display SNMP status you configured, use the following commands in Enable mode.

Command	Description
show snmp community	Displays community strings you add.
show snmp trap	Displays the configuring status of each kind of trap messages.
show snmp trap-receiver	Displays the configured trap receivers and the source interface and source IP address that is configured to be used in trap messages.

This example shows how to display the configured SNMP community strings.

```
DUT-1#show snmp community
**********************************************************************
                          SNMP Community List
**********************************************************************
 ID             Community Name      AccessRight
----------------------------------------------------------------------
  1         [          everyone]    Read-Only
  2         [      administrator]    Read/Write
----------------------------------------------------------------------
DUT-1#
```

Chapter 15 Configuring System Message Logging

The chapter 15 describes how to configure system message logging on your system.

This chapter consists of these sections:

- Understanding System Message Logging
- Configuring System Message Logging
- Displaying System Message Logging
- Displaying System Message Log
- Removing System Message Log

15.1 Understanding System Message Logging

Logging mechanism of VX-MD3024 system forwards all log messages generated by system and debug commands to the logging process. The logging process performs function distribute log messages to various destinations like as local buffer, NVRAM, terminal and remote syslog server and so on. The logging process can forward messages to console.

Users can configure kind and class of messages to be forwarded to console or other destinations, and configure sender address of log message to forward outside as a specific interface address. And in case of storing log messages in the system, you can configure maximum buffer size according to limit of buffer or NVRAM size. The buffer is circular, so newer messages overwrite older messages after the buffer is full.

You can configure facility and class of log message in order to store specific log messages. You can configure also the facility of each kind of log message to the facility you want.

You can show log messages stored in the internal buffer and NVRAM through telnet or console, and show also log messages on the remote syslog server.

15.2 Configuring System Message Logging

This section describe how to configure the system message logging:

- ✓ Default System Message Logging Configuration
- ✓ Setting the Message Display Destination Device
- ✓ Configuring Maximum Message Entry Size
- ✓ Configuring Facility and Severity to Log Message
- ✓ Configuring Log Profile
- ✓ Configuring Syslog Source Interface

Default System Message Logging Configuration

The following table shows default system message logging configuration.

Feature	Default Setting
Message logging to console	Disabled
Maximum logging buffer size of local buffer	1,000 messages
Maximum logging buffer size of NVRMA	760 messages
Remote syslog server	Disabled
syslog source interface	Disabled

Setting the Message Display Destination Device

You can configure location of system message logging. The location of message logging can be divided internal buffer, system terminal or remote syslog server. The system internal buffer can be divided internal buffer that removes log messages in rebooting and nvram that maintains log messages in rebooting. You can configure the log messages received to display to the system console, all telnet terminals and user-connected telnet terminal.

Beginning in Enable mode, use the following commands to specify the location to log system messages.

	command	purpose
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**syslog local {buffer | nvram}**	Log messages to the internal buffer - Messages stored in the buffer can be removed in rebooting - Messages stored in the nvram can be maintained in rebooting

Step 3	**syslog terminal {console | telnet | this-session}**	Log messages to specified terminals For **console**, specify the system messages to be displayed in the system console For **telnet**, specify the system messages to be displayed in all telnet terminals connected to the system. For **this-session**, specify the system messages to be displayed in the terminal that you connect.
Step 4	**syslog remote** *ip-address*	Forward system messages to the remote syslog server
Step 5	**end**	Return to Enable mode
Step 6	**show syslog**	Verify your entries.
Step 7	**write memory**	(Optional) Save your entries to the configuration file

To disable logging to the console, use the **no syslog terminal console** command on global configuration mode, To disable logging to the nvram, use the **no syslog local nvram** command on global configuration mode.

This example shows how to configure message logging to the internal buffer and the syslog server of which IP address is 192.168.100.100 and display the configuration result.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#syslog local buffer
DUT-1(config)#syslog remote 192.168.100.100
DUT-1(config)#end
DUT-1#show syslog
+ syslog remote source-interface : default
+ syslog local max-entry-size : buffer = 1000, NVRAM  = 760
+ syslog configuration
   Facility    Severity    Target
-------------------------------------------------------------------------------
   all         debug      Local System(buffer)
   all         debug      Remote System(192.168.100.100)
DUT-1#
```

Configuring Maximum Message Entry Size

You cannot log all system messages because the limitation of memory size. You can configure the maximum entry size of the buffer or nvram according to the size of internal local buffer and nvram. The buffer is implemented with circular method, so newer message overwrite older message after the buffer is full.

To configure the maximum message entry size according to the location, use the following commands on global configuration mode.

Command	Description
syslog local buffer max-entry-size *number*	Configure the maximum message entry size of local buffer. The range is from 1 to 10,000, and the default value is 1,000.
syslog local nvram max-entry-size *number*	Configure the maximum message entry size of nvram. The range is from 1 to 760, and the default value is 760..

To configure the number of maximum message entries of local buffer and nvram as the default, use the **no syslog local buffer max-entry-size** commands, and the **no syslog local nvram max-entry-size** command in global configuration mode.

This example shows how to configure the number of maximum message entries in local buffer as 2000 and in nvram as 500.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#syslog local buffer max-entry-size 2000
DUT-1(config)#syslog local nvram max-entry-size 500
DUT-1(config)#end
DUT-1#write memory
[OK]
DUT-1#
```

Defining Message Facility Type and Severity Level

You can limit messages displayed to the selected device by specifying the facility and the severity level of the messages.

When you define destination device to the log messages, to limit messages displayed to the selected device, use the flowing command on global configuration mode.

Command	Description
syslog local {buffer | nvram} [**facility** *facility-name* **severity** *level*]	Save system messages to the local buffer - The messages stored in **buffer** are deleted in rebooting. - The messages stored in **nvram** are maintained after rebooting. Configure the facility and severity level of the log message to be saved in local buffer. - The facility is configured to all and severity level is configured to debug if not specify the facility and severity.
syslog terminal {console | telnet | this-session} [**facility** *facility-name* **severity** *level*]	Limit messages logged to the terminal. - The **console** limits the messages logged to the system console. - The **telnet** limits the messages logged to all telnet terminal connected the system. - The **this-session** limits the messages logged to only terminal connected to current user. Configure the facility and severity level of the logging messages to be saved in local buffer. - The facility is configured to all and severity level is configured to debug if not specify the facility and severity.
syslog remote *ip-address* [**facility** *facility-name* **severity** *level*]	Limit messages logged to the remote syslog server. Configure the facility and severity level of the log messages to be saved in local buffer. - The facility is configured to all and severity level is configured to debug if not specify the facility and severity.

This table describes the facility type of system messages.

Facility Type Keyword	Description
auth	Authorization system
daemon	System daemon
kern	Kernel
local0~7	Locally defined messages
user	User process

This table describes the severity level of system messages.

Level Keyword	Level	Description
emergencies	0	System unstable.
alerts	1	Immediate action needed
critical	2	Critical conditions
errors	3	Error conditions
warnings	4	Warning conditions
notifications	5	Normal but significant condition
informational	6	Informational messages only
debugging	7	Debugging messages

You can configure several conditions of the system messages logged to the same destinations at the same time.

This example shows how to configure location of the log messages as local buffer and display all system messages on condition that facility type is local0 and severity level is higher than information, and on condition that facility type is daemon and severity level is higher than error.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
DUT-1(config)#syslog local buffer facility local0 severity info
DUT-1(config)#syslog local buffer facility daemon severity err
DUT-1(config)#end
DUT-1#show syslog
+ syslog remote source-interface : default
+ syslog local max-entry-size : buffer = 1000, NVRAM  = 500
+ syslog configuration
Facility   Severity   Target
-------------------------------------------------------------------
   daemon      err       Local System(buffer)
   local0      info      Local System(buffer)
DUT-1#
```

Configuring Log Profile

VX-MD3024 performs various functions related on multiplayer switch, operation, administration and maintenance, and so on. The system messages generated by these functions are classified as daemon in all logging system.

In case that you want to save the system messages related on specific functions of them, VX-MD3024 supports to change the facility configuration of system messages generated by the functions. The facility for system messages can be controlled by log profile.

You can configure the facility for the following functions in the system log profiles.

- dhcp-server: message generated in DHCP server
- alarm: alarm message of the system
- system-oam: system initialization and link up/down messages
- command: history message from user's input commands
- user-session: user's login/logout message from console and telnet
- dhcp-snoop: the message generated by DHCP snoop function
- vdsl: VDSL link up/down and other VDSL related message
- stp: Spanning tree related message
- pim: PIM protocol related message

- rip: RIP protocol related message
- ospf: OSPF protocol related message

The facility of the default log profile is configured to daemon for all functions described above. Beginning in Enable mode, follow these steps to configure facility for all functions defined in log profile by user.

	command	purpose
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**log-profile**	Enter log profile configuration mode.
Step 3	**alarm facility** *facility-name*	Configure facility for alarm messages - The *facility-name* can use auth, daemon, kern, local0~7, and user.
Step 4	**command facility** *facility-name*	Configure the facility for command messages
Step 5	**dhcp-server facility** *facility-name*	Configure the facility for dhcp-server messages
Step 6	**dhcp-snoop facility** *facility-name*	Configure the facility for dhcp-snoop messages
Step 7	**stp facility** *facility-name*	Configure the facility for stp messages
Step 8	**system-oam facility** *facility-name*	Configure the facility for system-oam messages
Step 9	**user-session facility** *facility-name*	Configure the facility for user-session messages
Step 10	**vdsl facility** *facility-name*	Configure the facility for vdsl messages
Step 11	**end**	Return to Enable mode
Step 12	**show log-profile**	Verify your entries
Step 13	**write memory**	(Optional) Save your entries in the configuration file

This example shows how to configure the facility for alarm messages to local0 and the facility for command messages to user.

```
DUT-1#configure terminal
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#log-profile
DUT-1(config-log-profile)#alarm facility local0
DUT-1(config-log-profile)#command facility user
DUT-1(config-log-profile)#end
DUT-1#
```

To display the logging configuration of the facility for the system message, use the following command in Enable mode.

Command	Description
show log-profile	Display the configuration of the facility in the log-profile

The following example shows how to display the configuration of the facility in the log-profile.

```
DUT-1#show log-profile
Logging Type    Facility
------------------------------------------------------------------------------
dhcp-server     daemon
alarm          daemon
system-oam      daemon
command        daemon
user-session    daemon
dhcp-snoop      daemon
vdsl           daemon
stp            daemon
DUT-1#
```

Configuring Syslog Source Interface

When two or more Layer 3 interfaces exist on your system and IP addresses are assigned for each Layer 3 interface, the source IP address of syslog messages can be assigned differently according to route information of destination IP address. In general, users can easily manage the received log messages when source IP address is assigned to the representative IP address registered in the

system.

You can configure only IP address of specific Layer 3 interface to IP address of the syslog source interface regardless of the destination Layer 3 interface.

Beginning in Enable mode, follow these steps to configure syslog source interface.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode
Step 2	**syslog remote source-interface** *interface-name*	Configure the source interface of syslog message The *interface-name* is the Layer 3 interface that used for source IP address when sending syslog messages.
Step 3	**end**	Return to Enable mode
Step 4	**show syslog**	Verify the syslog source interface configuration.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

To set the syslog source interface to the default configuration, use the **no syslog remote source-interface** command in global configuration mode.

This example shows how to configure the syslog source interface to the Layer 3 interface which is the VLAN1.10.

```
DUT-1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DUT-1(config)#syslog remote source-interface vlan1.10
DUT-1(config)#end
DUT-1#
```

15.3 Displaying System Message Logging

Beginning in Enable mode, use the following command in order to verify the logging configuration of the system message.

Command	Description
show syslog	Display the logging configuration of the system message.

The following is an example displaying the logging configuration of the system message.

```
DUT-1#show syslog
+ syslog remote source-interface : vlan1.10(192.168.40.201)
+ syslog local max-entry-size : buffer = 100, NVRAM  = 500
+ syslog configuration
Facility   Severity   Target
-------------------------------------------------------------------
   daemon      err       Local System(buffer)
   local0      info      Local System(buffer)
```

15.4 Displaying System Message Log

You can connect the telnet or console to show the system log messages stored in the system. Beginning in Enable mode, use the following command in order to verify the system log messages stored in the system.

Command	Description
show log buffer *type* [**oldest-first**]	Display the system log messages stored in the local buffer. - For **type**, select a type of {alarm | command | dhcp-server | dhcp-snoop | ospf | pim | rip | stp | system-oam | user-session | vdsl | all}. - If you add **oldest-first** keyword, you can show the log message from the oldest one. If you skip oldest-first, you can show the log message from the newest one.
show log nvram *type* [**oldest-first**]	Display the system log message stored in nvram. - Select a type of {alarm | command | dhcp-server | dhcp-snoop | ospf | pim | rip | stp | system-oam | user-session | vdsl | all}. - If you add **oldest-first** keyword, you can show the log message from the oldest one. If you skip oldest-first, you can show the log message from the newest one.

This example shows how to display the system log messages stored in local buffer.

```
DUT-1#show log buffer all
max-entry-size : 1000, current-entry-count : 100
Nov 30 04:45:10 <6>[CMD]: (root@210.121.174.215)show syslog
Nov 30 04:44:41 <6>[DHCP-SVR]: DHCPREQUEST for 192.168.2.152 (210.121.174.254)
from 00:01:02:97:91:fa via vlan1.10: ignored (unknown subnet).
Nov 30 04:44:41 <7>[DHCP-SVR]: accepting packet with data after udp payload.
Nov 30 04:44:41 <7>[DHCP-SVR]: ip length 335 disagrees with bytes received 339.
Nov 30 04:44:41 <7>[DHCP-SVR]: accepting packet with data after udp payload.
(output truncated)
```

15.5 Removing System Message Log

You can delete the system log messages stored in the system. Beginning in Enable mode, use the following command in order to delete the log message stored in the system.

Command	Description
clear log buffer *[type]*	Delete the log message stored in local buffer. - To delete only specified type of log messages, select a type of {alarm | command | dhcp-server | dhcp-snoop | ospf | pim | rip | stp | system-oam | user-session | vdsl | all}. - If you skip *type*, you can delete all log messages.
clear log nvram *[type]*	Delete the log message stored in nvram. - To delete only specified type of log messages, select a type of {alarm | command | dhcp-server | dhcp-snoop | ospf | pim | rip | stp | system-oam | user-session | vdsl | all}. - If you skip *type*, you can delete all log messages.

This example shows how to delete only log messages related to user-session of the log messages in local buffer, and delete all log messages stored in nvram.

```
DUT-1#clear log buffer user-session
DUT-1#clear log nvram
DUT-1#
```

Chapter 16. RADIUS & TACACS+

16.1. Controlling System Access with RADIUS

This section describes how to enable and configure the Remote Authentication Dial-In User Service (RADIUS), which provides detailed accounting information and flexible administrative control over authentication and authorization processes. RADIUS is facilitated through AAA and can be enabled only through AAA commands.

This section contains this configuration information

- ✓ Understanding RADIUS
- ✓ RADIUS Operation
- ✓ Configuring RADIUS
- ✓ Displaying the RADIUS Configuration

Understanding RADIUS

RADIUS is a distributed client/server system that secures networks against unauthorized access. RADIUS clients run on VX-MD3024. Clients send authentication requests to a central RADIUS server, which contains all user authentication and network service access information. The RADIUS host is normally a multiuser system running RADIUS server software from Livingston, Merit, Microsoft, or another software provider. For more information, refer to the RADIUS server documentation.

Use RADIUS in these network environments that require access security:

- Networks with multiple-vendor access servers, each supporting RADIUS. For example, access servers from several vendors use a single RADIUS server-based security database. In an IP-based network with multiple vendors' access servers; dial-in users are authenticated through a RADIUS server that has been customized to work with the Kerberos security system.
- Turnkey network security environments in which applications support the RADIUS protocol, such as in an access environment that uses a *smart card* access control system. In one case, RADIUS has been used with Enigma's security cards to validate users and to grant access to network resources.
- Networks already using RADIUS. You can add a switch containing a RADIUS client to the network.

This might be the first step when you make a transition to a TACACS+ server.

- Network in which the user must only access a single service. Using RADIUS, you can control user access to a single host, to a single utility such as Telnet, or to the network through a protocol such as IEEE 802.1X.
- Networks that require resource accounting. You can use RADIUS accounting independently of RADIUS authentication or authorization. The RADIUS accounting functions allow data to be sent at the start and end of services, showing the amount of resources (such as time, packets, bytes, and so forth) used during the session. An Internet service provider might use a freeware-based version of RADIUS access control and accounting software to meet special security and billing needs.

RADIUS is not suitable in these network security situations:

- Multiprotocol access environments. RADIUS does not support AppleTalk Remote Access (ARA), NetBIOS Frame Control Protocol (NBFCP), NetWare Asynchronous Services Interface (NASI), or X.25 PAD connections.
- Switch-to-switch or router-to-router situations. RADIUS does not provide two-way authentication.
- Networks using a variety of services. RADIUS generally binds a user to one service model.

RADIUS Operation

When a user attempts to log in and authenticate to a switch that is access controlled by a RADIUS server, the following events occur:

1. The user is prompted to enter a username and password.
2. The username and encrypted password are sent over the network to the RADIUS server.
3. The user receives one of these responses from the RADIUS server:

    a. ACCEPT—The user is authenticated.

    b. REJECT—The user is either not authenticated and is prompted to re-enter the username and password, or access is denied.

c. CHALLENGE—A challenge requires additional data from the user.

d. CHALLENGE PASSWORD—A response requests the user to select a new password.

The ACCEPT or REJECT response is bundled with additional data that is used for privileged EXEC or network authorization. Users must first successfully complete RADIUS authentication before proceeding to RADIUS authorization, if it is enabled. The additional data included with the ACCEPT or REJECT packets includes these items:

- Telnet, SSH, rlogin, or privileged EXEC services
- Connection parameters, including the host or client IP address, access list, and user timeouts

Configuring RADIUS

This section describes how to configure your system to support RADIUS. At a minimum, you must identify the host or hosts that run the RADIUS server software and define the method lists for RADIUS authentication. You can optionally define method lists for RADIUS authorization and accounting.

A method list defines the sequence and methods to be used to authenticate, to authorize, or to keep accounts on a user. You can use method lists to designate one or more security protocols to be used (such as TACACS+ or local username lookup), thus ensuring a backup system if the initial method fails. The software uses the first method listed to authenticate, to authorize, or to keep accounts on users; if that method does not respond, the software selects the next method in the list. This process continues until there is successful communication with a listed method or the method list is exhausted.

You should have access to and should configure a RADIUS server before configuring RADIUS features on your system.

(1) Default RADIUS Configuration

RADIUS and AAA are disabled by default.

To prevent a lapse in security, you cannot configure RADIUS through a network management application. When enabled, RADIUS can authenticate users accessing the system through the CLI.

(2) Identifying the RADIUS Server Host

Switch-to-RADIUS-server communication involves several components:

- Host name or IP address
- Authentication destination port
- Accounting destination port
- Key string
- Timeout period
- Retransmission value

You identify RADIUS security servers by their IP address or their IP address and specific UDP port numbers. The combination of the IP address and the UDP port number creates a unique identifier, allowing different ports to be individually defined as RADIUS hosts providing a specific AAA service. This unique identifier enables RADIUS requests to be sent to multiple UDP ports on a server at the same IP address.

If two different host entries on the same RADIUS server are configured for the same service—for example, accounting—the second host entry configured acts as a fail-over backup to the first one. Using this example, if the first host entry fails to provide accounting services, the system tries the second host entry configured on the same device for accounting services. (The RADIUS host entries are tried in the order that they are configured.)

A RADIUS server and the switch use a shared secret text string to encrypt passwords and exchange responses. To configure RADIUS to use the AAA security commands, you must specify the host running the RADIUS server daemon and a secret text (key) string that it shares with the system.

The timeout, retransmission, and encryption key values can be configured globally for all RADIUS servers, on a per-server basis, or in some combination of global and per-server settings. To apply these settings globally to all RADIUS servers communicating with the system, use the three unique global configuration commands: **radius-server timeout**, **radius-server retransmit**, and **radius-server key**. To apply these values on a specific RADIUS server, use the **radius-server host** global configuration command.

Note

If you configure both global and per-server functions (timeout, retransmission, and key commands) on the system, the per-server timer, retransmission, and key value commands override global timer, retransmission, and key value commands. For information on configuring these setting on all RADIUS servers, see the “Configuring Settings for All RADIUS Servers”

Beginning in privileged EXEC mode, follow these steps to configure per-server RADIUS server communication. This procedure is required.

	Command	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**radius-server host** *ip-address* [**default** | [**auth-port** *port-number*] [**timeout** *seconds*] [**retries** *retries*] [**key** *string*]]	Specify the IP address of the remote RADIUS server host. (Optional) **default:** If you use default without specific auth-port, timeout, retries and key information, the specified host would use the pre-defined default values. (Optional) For **auth-port** *port-number*, specify the UDP destination port for authentication requests. (Optional) For **timeout** *seconds*, specify the time interval that the system waits for the RADIUS server to reply before resending. The range is 1 to 1000. This setting overrides the radius-server timeout global configuration command setting. If no timeout is set with the radius-server host command, the setting of the radius-server timeout command is used. (Optional) For **retries** *retries*, specify the number of times a RADIUS request is resent to a server if that server is not responding or responding slowly. The range is 1 to 1000. If no retransmit value is set with the radius-server host command, the setting of the radius-server retransmit global configuration command is used. (Optional) For **key** *string*, specify the authentication and encryption key used between the system and the RADIUS daemon running on the RADIUS server. **Note** The key is a text string that must match the encryption key

		used on the RADIUS server. Always configure the key as the last item in the radius-server host command. Leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in your key, do not enclose the key in quotation marks unless the quotation marks are part of the key. To configure the system to recognize more than one host entry associated with a single IP address; enter the following command as many times as necessary, making sure that each UDP port number is different. The system software searches for hosts in the order in which you specify them. Set the timeout, retransmit, and encryption key values to use with the specific RADIUS host.
Step 3	**end**	Return to privileged EXEC mode.
Step 4	**show running-config**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

To remove the specified RADIUS server, use the **no radius-server host** *ip-address* global configuration command.

This example shows how to configure one RADIUS server to be used for default auth-port, retry counts and how to display the configured RADIUS server information on the system.

```
DUT-1#configure terminal
DUT-1(config)#service aaa
DUT-1(config)#radius-server host 192.168.2.244 default
DUT-1(config)#end
DUT-1#show aaa radius
************************************************************************
RADIUS server information
************************************************************************
RADIUS group 1 used
------------------------------------------------------------------------
index | server group information
------------------------------------------------------------------------
0 | group name   : NULL
| secret key   : versatek_secret
```

```
| timeout     : 3
| retries     : 3
| auth port   : 1812
| server ip   : 1 used
|   0. ip address : 192.168.2.140
-------------------------------------------------------------------------
```

(3) Configuring RADIUS Login Authentication

To configure AAA authentication, you define a named list of authentication methods and then apply that list to various interfaces. The method list defines the types of authentication to be performed and the sequence in which they are performed; it must be applied to a specific interface before any of the defined authentication methods are performed. The only exception is the default method list (which, by coincidence, is named *default*). The default method list is automatically applied to all interfaces except those that have a named method list explicitly defined.

A method list describes the sequence and authentication methods to be queried to authenticate a user. You can designate one or more security protocols to be used for authentication, thus ensuring a backup system for authentication in case the initial method fails. The software uses the first method listed to authenticate users; if that method fails to respond, the software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle—meaning that the security server or local username database responds by denying the user access—the authentication process stops, and no other authentication methods are attempted.

Beginning in privileged EXEC mode, follow these steps to configure login authentication. This procedure is required.

	Command (versatek)	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service aaa**	Enable AAA service.

Step 3	**aaa authentication login** (**default** | *list_name*) **1st** { **local** | **radius** { **all** | *group_name* } | **tacacs** { **all** | *group_name* } } **2nd** { **none** | **local** | **radius** { **all** | *group_name* } | **tacacs** { **all** | *group_name* } } **3rd** { **none** | **local** | **radius** { **all** | *group_name* } | **tacacs** { **all** | *group_name* } }	Create a login authentication method list. To create a default list that is used when a named list is not specified in the **login authentication** command, use the **default** keyword followed by the methods that are to be used in default situations. The default method list is automatically applied to all interfaces. For *list-name*, specify a character string to name the list you are creating. You can specify the actual method the authentication algorithm tries to 3 times. The additional methods of authentication are used only if the previous method returns an error, not if it fails. Select one of these methods: - **local** : Use the line password for authentication. - **radius** : Use RADIUS authentication. Before you can use this authentication method, you must configure the RADIUS server. In this case, if you select **all** key-word, the system tries to all defined RADIUS server on your system. If you specify a group-name, the system would try only the RADIUS servers included in the radius group. - **tacacs**: Use TACACS+ authentication. Before you can use this authentication method, you must configure the TACACS+ server. If you select all key-word, the system tries to all defined TACACS+ servers on your system. If you specify a group-name, the system would try only the TACACS+ servers included in the tacacs group. - **none**: Do not use any authentication for login.
Step 4	**line** { **console** | **vty** } *line-number [ending-line-number]*	Enter line configuration mode, and configure the lines to which you want to apply the authentication list.
Step 5	**login authentication** { **default** | *list-name* }	Apply the authentication list to a line or set of lines. - If you specify **default**, use the default list created with the **aaa authentication login** command. - For *list-name*, specify the list created with the **aaa authentication login** command.
Step 6	**end**	Return to privileged EXEC mode.
Step 7	**show running-config**	Verify your entries.
Step 8	**write memory**	(Optional) Save your entries in the configuration file.

To disable AAA, use the "**no service aaa"** global configuration command. To disable AAA authentication, use the **no aaa authentication login** global configuration command. To either disable RADIUS authentication for login or to return to default values, use the **no login authentication** line configuration command.

This example shows how to configure RADIUS server to be used at first time and local password at next time for authentication.

```
DUT-1#configure terminal
DUT-1(config)#service aaa
DUT-1(config)#aaa authentication login default 1st radius all 2nd local 3rd
none
DUT-1(config)#line vty 0 4
DUT-1(config-line)#login authentication default
DUT-1(config-line)#end
```

This example shows how to display the configured login policy list.

```
DUT-1#show aaa login-policy-list
************************************************************************
 Login policy list, used (1)
************************************************************************
 Index | List name         | # | Type    | Subtype | Group name
------------------------------------------------------------------------
    0 | default_login_seq | 0 | local   | none    | none
      |                   | 1 | none    | none    | none
      |                   | 2 | none    | none    | none
------------------------------------------------------------------------
```

This example shows how to display the configured login policy per line.

```
DUT-1#show aaa line-login-policy
************************************************************************
Login policy at each line
************************************************************************
Line type | Line num | Login policy name            | Policy index
```

```
------------------------------------------------------------------------
console   |      0 | policy none, local login      | none
------------------------------------------------------------------------
vty       |      0 | policy none, local login      | none
          |      1 | policy none, local login      | none
          |      2 | policy none, local login      | none
------------------------------------------------------------------------
```

(4) Configuring Settings for All RADIUS Servers

Beginning in privileged EXEC mode, follow these steps to configure global communication settings between the system and all RADIUS servers.

	Command (versatek)	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**radius-server key** *string*	Specify the shared secret text string used between the system and all RADIUS servers. **Note** The key is a text string that must match the encryption key used on the RADIUS server. Always configure the key as the last item in the radius-server host command. Leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in your key, do not enclose the key in quotation marks unless the quotation marks are part of the key.
Step 3	**radius-server retries** *retries*	Specify the number of times the system sends each RADIUS request to the server before giving up. The default is 3; the range 1 to 1000.
Step 4	**radius-server timeout** *seconds*	Specify the number of seconds a system waits for a reply to a RADIUS request before resending the request. The default is 5 seconds; the range is 1 to 1000.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**show running-config**	Verify your settings.
Step 7	**write memory**	(Optional) Save your entries in the configuration file.

To return to the default setting for the retransmit and timeout, use the no forms of these commands.

(5) Defining AAA server Group

You can configure the system to use AAA server groups to group existing server hosts for authentication. You select a subset of the configured server hosts and use them for a particular service. The server group is used with a global server-host list, which lists the IP addresses of the selected server hosts.

Server groups also can include multiple host entries for the same server if each entry has a unique identifier (the combination of the IP address and UDP port number), allowing different ports to be individually defined as RADIUS hosts providing a specific AAA service. If you configure two different host entries on the same RADIUS server for the same service, (for example, accounting), the second configured host entry acts as a fail-over backup to the first one.

You use the server group server configuration command to associate a particular server with a defined group server. You can either identify the server by its IP address or identify multiple host instances or entries by using the optional auth-port and acct-port keywords.

Beginning in privileged EXEC mode, follow these steps to define the AAA server group and associate a particular RADIUS server with it:

	Command (versatek)	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**radius-server host** *ip-address* [**default** | ([**auth-port** *port-number*] [**timeout** *seconds*] [**retries** *retries*] [**key** *string*])]	Specify the IP address of the remote RADIUS server host. (Optional) **default:** If you use default without specific auth-port, timeout, retries and key information, the specified host would use the pre-defined default values. (Optional) For **auth-port** *port-number*, specify the UDP destination port for authentication requests. (Optional) For **timeout** *seconds*, specify the time interval that the system waits for the RADIUS server to reply before resending. The range is 1 to 1000. This setting overrides the radius-server timeout global configuration command setting. If no timeout is set with the radius-server host command, the setting of the radius-server timeout command is used. (Optional) For **retries** *retries*, specify the number of times a RADIUS request is resent to a server if that server is not

		responding or responding slowly. The range is 1 to 1000. If no retransmit value is set with the radius-server host command, the setting of the radius-server retransmit global configuration command is used. (Optional) For **key** *string*, specify the authentication and encryption key used between the system and the RADIUS daemon running on the RADIUS server. **Note** The key is a text string that must match the encryption key used on the RADIUS server. Always configure the key as the last item in the radius-server host command. Leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in your key, do not enclose the key in quotation marks unless the quotation marks are part of the key. To configure the system to recognize more than one host entry associated with a single IP address; enter this command as many times as necessary, making sure that each UDP port number is different. The system software searches for hosts in the order in which you specify them. Set the timeout, retransmit, and encryption key values to use with the specific RADIUS host.
Step 3	**service aaa**	Enable AAA.
Step 4	**aaa group server radius** *group-name*	Define the AAA server-group with a group name. This command puts the system in a server group configuration mode.
Step 5	**server** *ip-address*	Associate a particular RADIUS server with the defined server group. Repeat this step for each RADIUS server in the AAA server group. Each server in the group must be previously defined in Step 2.
Step 6	**end**	Return to privileged EXEC mode.
Step 7	**show running-config**	Verify your entries.
Step 8	**write memory**	(Optional) Save your entries in the configuration file.
Step 9		Enable RADIUS login authentication. See the “Configuring

	RADIUS Login Authentication” section.

To remove the specified RADIUS server, use the **no radius-server host** *ip-address* global configuration command. To remove a server group from the configuration list, use the **no aaa group server radius** *group-name* global configuration command. To remove the IP address of a RADIUS server, use the **no server** *ip-address* server group configuration command.

In this example, the system is configured to recognize two different RADIUS group servers (group1 and group2). The second host entry acts as a fail-over backup to the first entry.

```
DUT-1#configure terminal
VX-MD3024(config)#radius-server host 192.168.10.11 auth-port 1000
VX-MD3024(config)#radius-server host 192.168.20.22 auth-port 1745
DUT-1(config)#service aaa
DUT-1(config)#aaa group server radius group1
VX-MD3024(config-aaa-group)#server 192.168.10.11
VX-MD3024(config-aaa-group)#exit
VX-MD3024(config)#aaa group server radius group2
VX-MD3024(config-aaa-group)#server 192.168.20.22
DUT-1(config-aaa-group)#end
DUT-1#
```

Displaying the RADIUS Configuration

To display the configured RADIUS server list and RADIUS group-list, use the **show aaa radius** privileged EXEC command. To display the configured login policy per line, use the show **aaa line-login-policy** privileged EXEC command.

16.2. Controlling System Access with TACACS+

This section describes how to enable and configure Terminal Access Controller Access Control System Plus (TACACS+), which provides flexible administrative control over authentication and authorization processes. TACACS+ is facilitated through authentication, authorization, accounting (AAA) and can be enabled only through AAA commands.

This section contains this configuration information

- ✓ Understanding TACACS+
- ✓ TACACS+ Operation
- ✓ Configuring TACACS+
- ✓ Displaying the TACACS+ Configuration

Understanding TACACS+

TACACS+ is a security application that provides centralized validation of users attempting to gain access to your switch. TACACS+ services are maintained in a database on a TACACS+ daemon typically running on a UNIX or Windows NT workstation. You should have access to and should configure a TACACS+ server before the configuring TACACS+ features on your switch.

TACACS+ provides for separate and modular authentication, authorization, and accounting facilities. TACACS+ allows for a single access control server (the TACACS+ daemon) to provide each service—authentication, authorization, and accounting—independently. Each service can be tied into its own database to take advantage of other services available on that server or on the network, depending on the capabilities of the daemon.

TACACS+ Operation

When a user attempts a simple ASCII login by authenticating to a switch using TACACS+, this process occurs:

1. When the connection is established, the switch contacts the TACACS+ daemon to obtain a username prompt, which is then displayed to the user. The user enters a username, and the switch then contacts the TACACS+ daemon to obtain a password prompt. The switch displays the password prompt to the user, the user enters a password, and the password is then sent to the TACACS+ daemon. TACACS+ allows a conversation to be held between the daemon and the user until the daemon receives enough information to authenticate the user. The daemon prompts for a username and password combination, but can include other items, such as the user's mother's maiden name.
2. The system eventually receives one of these responses from the TACACS+ daemon:

a. ACCEPT - The user is authenticated and service can begin. If the system is configured to require authorization, authorization begins at this time.

b. REJECT - The user is not authenticated. The user can be denied access or is prompted to retry the login sequence, depending on the TACACS+ daemon.

c. ERROR - An error occurred at some time during authentication with the daemon or in the network connection between the daemon and the system if an ERROR response is received, the system typically tries to use an alternative method for authenticating the user.

d. CONTINUE- The user is prompted for additional authentication information.

3. If TACACS+ authorization is required, the TACACS+ daemon is again contacted, and it returns an ACCEPT or REJECT authorization response. If an ACCEPT response is returned, the response contains data in the form of attributes that direct the EXEC or NETWORK session for that user, determining the services that the user can access:

- Telnet, SSH, rlogin, or privileged EXEC services
- Connection parameters, including the host or client IP address, access list, and user timeouts

Configuring TACACS+

This section describes how to configure your switch to support TACACS+. At a minimum, you must identify the host or hosts maintaining the TACACS+ daemon and define the method lists for TACACS+ authentication. You can optionally define method lists for TACACS+ authorization and accounting. A method list defines the sequence and methods to be used to authenticate, to authorize, or to keep accounts on a user. You can use method lists to designate one or more security protocols to be used, thus ensuring a backup system if the initial method fails. The software uses the first method listed to authenticate, to authorize, or to keep accounts on users; if that method does not respond, the software selects the next method in the list. This process continues until there is successful communication with a listed method or the method list is exhausted.

(1) Default TACACS+ Configuration

TACACS+ and AAA are disabled by default.

To prevent a lapse in security, you cannot configure TACACS+ through a network management application. When enabled, TACACS+ can authenticate users accessing the switch through the CLI.

(2) Identifying the TACACS+ Server Host and Setting the Authentication Key

You can configure the system to use a single server or AAA server groups to group existing server hosts for authentication. You can group servers to select a subset of the configured server hosts and use them for a particular service. The server group is used with a global server-host list and contains the list of IP addresses of the selected server hosts.

Beginning in privileged EXEC mode, follow these steps to identify the IP host or host maintaining TACACS+ server and optionally set the encryption key:

	Command (versatek)	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**tacacs-server host** *ip-address* [**default** | [**auth-port** *port-number*] [**timeout** *seconds*] [**key** *string*]]	Identify the IP host maintaining a TACACS+ server. Enter this command multiple times to create a list of preferred hosts. The software searches for hosts in the order in which you specify them. (Optional) **default**: If you use default without specific auth-port, timeout, retries and key information, the specified host would use the pre-defined default values. (Optional) For **auth-port** *port-number*, specify a server port number. The default is port 49. the range is 1 to 65535. (Optional) For **timeout** *seconds*, specify a time in seconds the system waits for a response from the daemon before it times out and declares an error. The default is 5 seconds. The range is 1 to 1000 seconds. (Optional) For **key** *string*, specify the encryption key for encrypting and decrypting all traffic between the system and the TACACS+ daemon. You must configure the same key on the TACACS+ daemon for encryption to be

		successful.
Step 3	**service aaa**	Enable AAA
Step 4	**aaa group server tacacs** *group-name*	(Optional) Define the AAA server-group with a group name. This command puts the system in a server group sub-configuration mode.
Step 4	**server** *ip-address*	(Optional) Associate a particular TACACS+ server with the defined server group. Repeat this step for each TACACS+ server in the AAA server group. Each server in the group must be previously defined in Step 2.
Step 3	**end**	Return to privileged EXEC mode.
Step 4	**show aaa tacacs**	Verify your entries.
Step 5	**write memory**	(Optional) Save your entries in the configuration file.

To remove the specified TACACS+ server address, use the **no tacacs-server host** *ip-address* global configuration command. To remove a server group from the configuration list, use **the no aaa group server tacacs** *group-name* global configuration command. To remove the IP address of a TACACS+ server, use the **no server** *ip-address* server group sub-configuration command.

(3) Configuring TACACS+ Login Authentication

To configure AAA authentication, you define a named list of authentication methods and then apply that list to various interfaces. The method list defines the types of authentication to be performed and the sequence in which they are performed; it must be applied to a specific interface before any of the defined authentication methods are performed. The only exception is the default method list (which, by coincidence, is named *default*). The default method list is automatically applied to all interfaces except those that have a named method list explicitly defined. A defined method list overrides the default method list.

A method list describes the sequence and authentication methods to be queried to authenticate a user. You can designate one or more security protocols to be used for authentication, thus ensuring a backup system for authentication in case the initial method fails. The software uses the first method

listed to authenticate users; if that method fails to respond, the software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle—meaning that the security server or local username database responds by denying the user access—the authentication process stops, and no other authentication methods are attempted.

Beginning in privileged EXEC mode, follow these steps to configure login authentication:

	Command (versatek)	Description
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**service aaa**	Enable AAA.
Step 3	**aaa authentication login** (**default** | *list_name*) **1st** { **local** | **radius** { **all** | *group_name* } | **tacacs** { **all** | *group_name* } } **2nd** { **none** | **local** | **radius** { **all** | *group_name* } | **tacacs** { **all** | *group_name* } } **3rd** { **none** | **local** | **radius** { **all** | *group_name* } | **tacacs** { **all** | *group_name* } }	Create a login authentication method list. To create a default list that is used when a named list is not specified in the **login authentication** command, use the **default** keyword followed by the methods that are to be used in default situations. The default method list is automatically applied to all interfaces. For *list-name*, specify a character string to name the list you are creating. You can specify the actual method the authentication algorithm tries to 3 times. The additional methods of authentication are used only if the previous method returns an error, not if it fails. Select one of these methods: - **local**: Use the line password for authentication. - **radius**: Use RADIUS authentication. Before you can use this authentication method, you must configure the RADIUS server. In this case, if you select **all** key-word, the system tries to all defined RADIUS server on your system. If you specify a group-name, the system would try only the RADIUS servers included in the radius group. - **tacacs**: Use TACACS+ authentication. Before you can use this authentication method, you must configure the TACACS+ server. If you select all key-word, the system tries to all defined TACACS+ servers on your system. If you specify a group-name, the system would try only the TACACS+ servers included in the tacacs group.

		- **none**: Do not use any authentication for login.
Step 4	**line** { **console** | **vty** } *line-number [ending-line-number]*	Enter line configuration mode, and configure the lines to which you want to apply the authentication list.
Step 5	**login authentication** { **default** | *list-name* }	Apply the authentication list to a line or set of lines. - If you specify **default**, use the default list created with the **aaa authentication login** command. - For *list-name*, specify the list created with the **aaa authentication login** command.
Step 6	**end**	Return to privileged EXEC mode.
Step 9	**show running-config**	Verify your entries.
Step 10	**write memory**	(Optional) Save your entries in the configuration file.

To disable AAA, use the "**no service aaa** global" configuration command. To disable AAA authentication, use the **no aaa authentication login** global configuration command. To either disable RADIUS authentication for login or to return to default values, use the **no login authentication** line configuration command.

Displaying the TACACS+ Configuration

To display TACACS+ server and server group lists, use the **show aaa tacacs** privileged EXEC command.